ENFIELD INLAND WETLAND & WATERCOURSES AGENCY

TUESDAY, MAY 18, 2010

REGULAR MEETING @ 7:00 PM

PUBLIC HEARING to follow (if applicable)

Council Chambers

ENFIELD TOWN HALL
820 ENFIELD STREET
ENFIELD, CT

INFORMATION PACKET

AGENDA
MEETING OF THE
ENFIELD INLAND WETLANDS AND WATERCOURSES AGENCY
TUESDAY, MAY 18, 2010 – **7:00 pm**
REGULAR MEETING

*****Council Chambers*****

********* ENFIELD TOWN HALL *********
*** 820 ENFIELD STREET***
** ENFIELD, CT 06082 **

REGULAR MEETING

1. Call to Order
2. Roll Call
3. Pledge of Allegiance
4. Executive Session

(Matters regarding specific employees, pending litigation, acquisition of real estate and / or matters exempt from disclosure requirements)

5. Public Hearing
6. Call to Order of Regular Meeting
7. Public Participation - Issues of concern not on the agenda
8. Correspondence
   a. Invasive Plant Symposium
   b. "Wetlands, Second Edition" by William J. Mitsch & James G. Gosselink - Chapter 16: Wetland Management and Protection
9. Commissioner's Correspondence
   a. Site Visit Updates
10. Approval of Minutes – April 29, 2010 & May 4, 2010
11. Wetlands Agent Report
12. Old Business
13. New Business
14. New Applications to be Received
    a. Applications to be received after Town deadline for Agenda

15. Other Business
    a. IWWA Fines Ordinance
    b. IWWA Fee Schedule
    c. IWWA Regulation Revisions
    d. **Next regular meeting is Tuesday June 1, 2010 at 7:00PM in the Council Chambers.**
16. Adjourn

Acronym Key for Dates:

Submitted	= Day it was Logged in by the Appropriate Town Office.
Rec'ed	= Received (Date of First Regular Meeting after the day of submission or 35 days, which ever is sooner)
PPE	= Petition Period Ends (14 Days from Receipt)
MAD	= Mandatory Action Date (65 Days from Receipt)
EMAD	= Extended Mandatory Action Date (Any combination up to 65 days from original MAD)
MPHCD	= Mandatory Public Hearing Closing Date (35 Days from opening of the public hearing)
EMPHCD	= Extended Mandatory Public Hearing Closing Date (Any combination up to 65 Days from first MPHCD)
MPHAD	= Mandatory Public Hearing Action Date (35 Days after close of the public hearing)
EMPHAD	= Extended Mandatory Public Hearing Action Date (Any combination up to 65 Days from first MPHAD)

*Applicant can consent to extend the time frame for any of the steps but the total of all extensions together cannot exceed 65 days

CORRESPONDENCE

INVASIVE PLANT SYMPOSIUM

Presented by the Connecticut Invasive Plant Working Group (CIPWG)

University of Connecticut, Storrs, CT
Thursday, October 14, 2010

Challenges and Successes: Working Cooperatively to Manage Invasive Plants

ALL WHO ARE INTERESTED IN INVASIVE PLANT ISSUES ARE INVITED to this symposium (8:00 a.m. - 4:00 p.m.) at the University of Connecticut, Storrs. This conference will address the importance of native habitats, how invasive species harm these habitats, and why cooperative efforts are vital to understanding and managing our natural landscapes. All interested people, including municipal staff (parks and recreation, public works, inland wetlands/conservation commissions), nursery, tree and landscape professionals, educators, students, landscape architects, gardening enthusiasts, state and federal employees, and members of conservation organizations are encouraged to attend.

The **Keynote Address, "The power of choice: new frontiers in invasive plant management and conservation,"** will be given by **Dr. Bernd Blossey**, Associate Professor, Department of Natural Resources, Cornell University.

Additional morning presentations will highlight native plants and legislative updates. Throughout the day a **poster session** and other **educational exhibits** will be featured.

Afternoon Session Topics are:

- Industry Perspective – What's Working
- Early Detection and Rapid Response
- Invasives Management Research
- Invaded Forests
- Cooperative Weed Management Areas
- Local Success Stories

Connecticut Invasive Plant Working Group

CONTINUING EDUCATION: Pesticide Recertification Credits and a variety of other continuing education credits will be offered (see website).

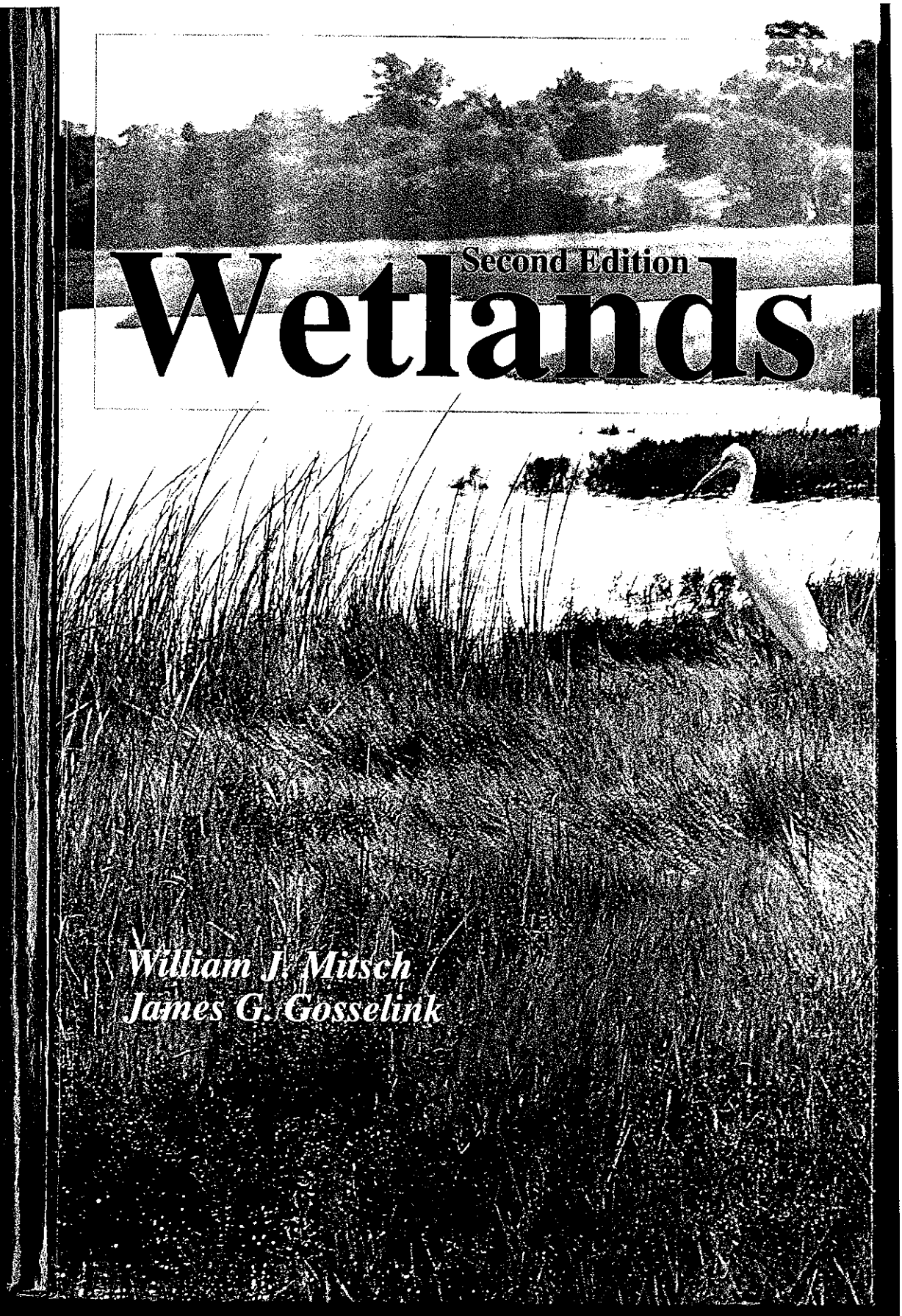
REGISTRATION includes parking and sustainable food:
$40 if postmarked by September 18; Students $25 – bring ID
Late registration $55 (postmarked after September 18 or for walk-in registrations)
Walk-in registrations only if space is available.

This symposium is funded in part by the New England Invasive Plant Center.

Full program and registration information are available on the CIPWG website: www.hort.uconn.edu/cipwg
or call (860) 486-6448 for more information

Second Edition

Wetlands



William J. Mitsch
James G. Gosselink

replacement method suggested an annual cost of from $0.4 to $1.1 million to replace the functions of a 2.5 km^2 peatland-lake complex on the island of Gotland, Sweden (Folke, 1991). This translates to a replacement cost of $1,600 ha^{-1} yr^{-1} ($650 acre^{-1} yr^{-1}), with most of the cost involved in replacing the biogeochemical processes of the wetland (52–82 percent of the cost) and less involved in replacing the hydrologic processes (7–40 percent) and food chain functions (8–11 percent) (see Table 15–6) (Folke, 1991). When the energy cost of the economic replacements was compared with the energy lost when the wetland was lost, the results were remarkably similar. If the 2.5 km^2 wetland were lost, the economic-replacement cost in energy terms would range from 3.5 to 12 x 10^9 kcal/yr; the ecosystem-loss calculation ranged from 13 to 18 x 10^9 kcal/yr. Again, the energy-analysis method gave a slightly higher estimate of the energy (and hence the money) cost of wetland loss than the replacement-cost method did.

Multiple Function Approach

Values placed on wetlands using these evaluation methods have ranged from very high to low. Although few people dispute that wetlands have many and varied values, the lack of consistent, accepted methodologies for comparing them with conventional economic goods and services limits the usefulness of the estimates that have been made. Perhaps the most comprehensive attempt to evaluate wetlands for management purposes is a joint project of Wildlife Habitat Canada and Environment Canada (Manning et al., 1990). Their process of valuing a wetland development project begins with applying a multiple-function screening that incorporates a series of specific standards or benchmarks reflecting applicable societal goals associated with wetlands. Most of the standards were identified from existing legislation, stated government goals and objectives, and scientific principles. A project that fails to satisfy one or more of these goals can often be eliminated, avoiding further, detailed analysis.

Major projects passing the initial screening must subsequently be evaluated in terms of their impact on identified social values. This process involves a cost accounting of the benefits of the project compared to the cost of natural wetland goods and services lost. In this process both the willingness-to-pay and the opportunity cost methodologies are used. The results of four pilot studies showed limitations in each of the methods but also the possibility for developing a more useful process for evaluating major development projects. One key element of the evaluation process is the need to recognize and conceptually separate the relationships among the ecological functions of wetlands, the recognizable benefits to society, and the socioeconomic values that can be placed on those benefits.

Wetland Management and Protection

16

Wetland management has meant both wetland alteration and protection. In earlier times wetland drainage was considered the only policy for managing wetlands. With the recognition of wetland values, wetland protection has been emphasized by many federal and state policies. Nevertheless, significant wetland alteration continues, particularly by dredging, filling, drainage, hydrologic modification, peat mining removal for mineral extraction, and water pollution. Wetlands can also be managed in their more or less natural state for certain objectives such as fish and wildlife enhancement, agricultural and aquaculture production, water quality improvement, and flood control.

The federal government in the United States has relied on executive orders, "no net loss" policy, and the Section 404 dredge-and-fill permit program of the Clean Water Act for wetland protection augmented by wetland protection programs in agriculture and the development of wetland delineation procedures. Some states have wetland protection laws although many more have relied on federal regulations. Many observers believe that individual states will assume more responsibility for protecting wetlands, whereas others believe that the federal government must continue in the lead in the now highly politicized field of wetland protection. International cooperation in wetland protection, particularly through the Ramsar Convention and the North American Waterfowl Management Plan, has been emphasized in recent years as policymakers have come to realize that wetland function knows no political boundaries.

The concept of wetland management has had different meanings at different times to different disciplines. Until the middle of the twentieth century, wetland management usually meant wetland drainage to many policymakers except for a few resource managers who maintained wetlands for hunting and fishing. Landowners were encouraged through government programs to tile and drain wetlands to make the land suitable for agriculture and other uses. Countless coastal wetlands were destroyed by dredging and filling for navigation and land development. There was little understanding of and concern for the inherent values of wetlands. The value of wetlands as wildlife habitats, particularly for waterfowl, was recognized in the first half of this century by some fish and game managers to whom wetland management often meant the maintenance of hydrologic conditions to optimize fish or waterfowl populations. Only relatively recently have other values such as those described in Chapter 15 been recognized.

Today the management of wetlands means setting several objectives, depending on the priorites of the wetland manager. In some cases, objectives such as preventing pollution from reaching wetlands and using wetlands as sites of wastewater treatment or disposal can be conflicting. Many floodplain wetlands are now managed and zoned to minimize human encroachment and maximize floodwater retention. Coastal wetlands are now included in coastal zone protection programs for storm protection and as sanctuaries and subsidies for estuarine fauna. In the meantime, wetlands continue to be altered or destroyed through drainage, filling, conversion to agriculture, water pollution, and mineral extraction.

Wetlands are now the focus of legal efforts to protect them but, as such, they are beginning to be defined by legal fiat rather than by the application of than ecological principles. Protection has been implemented through a variety of policies, laws, and regulations ranging from land-use policies to zoning restrictions to enforcement of dredge-and-fill laws. In the United States, wetland protection has historically been a national initiative, but some assistance has been provided by individual states. In the international arena, agreements to protect ecologically important wetlands throughout the world have been negotiated and ratified.

AN EARLY HISTORY OF WETLAND MANAGEMENT

The early history of wetland management, a history that still influences many people today, was driven by the misconception that wetlands were wastelands that should be avoided or, if possible, drained and filled. As described by Larson and Kusler (1979), "For most of recorded history, wetlands were regarded as wastelands if not bogs of treachery, mires of despair, homes of pests, and refuges for outlaw and rebel. A good wetland was a drained wetland free of this mixture of dubious social factors." In the United States this opinion of wetlands and shallow-water environments led to the destruction of more than half of the total wetlands in the lower 48 states (Fig. 16–1; see also Chap. 3).

Some public laws actually encouraged wetland drainage. Congress passed the Swamp Land Act of 1849, which granted to Louisiana the control of all swamplands and overflow lands in the state for the general purpose of controlling floods in the Mississippi Basin. In the following year the act was extended to the states of Alabama, Arkansas, California, Florida, Illinois, Indiana, Iowa, Michigan,

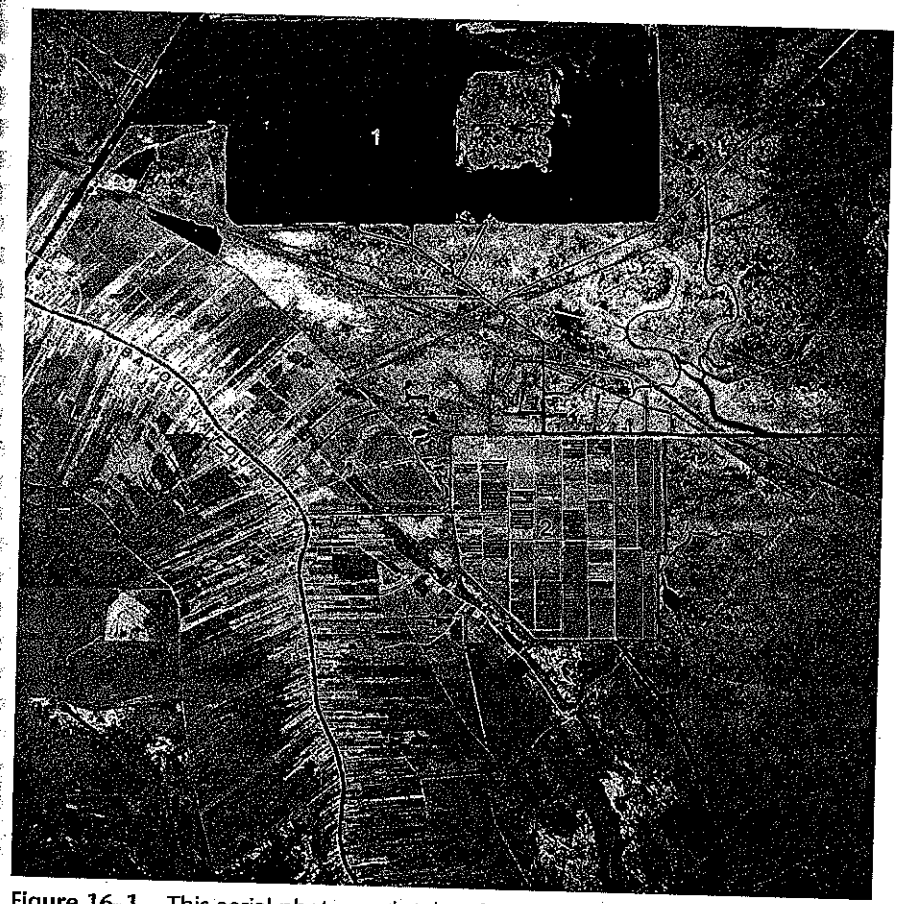


Figure 16–1. This aerial photograph taken from a U-2 plane is a scene of a fresh marsh along an abandoned Mississippi River distributary, Bayou Lafourche. Residential and agricultural development has occurred on the high natural levees of this bayou. The large rectangular lake (1) was an agricultural development in the early part of the century. The levees were breached by a severe storm and it was abandoned. Below it (2) is a similar development, still in sugarcane production. The soil surface inside the levees is now about 2 m below the surrounding water level due to compaction and oxidation. Manmade canals (3) are straight and deep, natural channels (4) are tortuous and shallow. Infared imagery from 20,000 meters (65,000 feet) with 30 cm (12-inch) focal length lens. (*Photograph by NASA, Ames Research Center, Flight 78-143, October 9, 1978*)

Mississippi, Missouri, Ohio, and Wisconsin. Minnesota and Oregon were added in 1860. The act was designed to decrease federal involvement in flood control and drainage by transferring federally owned wetlands to the states, leaving to them the initiative of "reclaiming" wetlands through activities such as levee construction and drainage. By 1954, almost 100 years after the act was established, an estimated 26 million hectares (65 million acres) of land had been ceded to those 15 states for reclamation. Ironically, although the federal government passed the Swamp Land Act to get out of the flood-control business and the states sold those lands to individuals for pennies per acre, the private owners subsequently exerted great pressure on both national and state governments to protect them from floods. Further, governments are now paying enormous sums to buy those lands back for conservation purposes. Although current government policies are generally in direct opposition to the Swamp Land Act and it is now disregarded, the act cast the initial wetland policy of the United States government in the direction of wetland elimination.

Other actions led to the rapid decline of the nation's wetlands. An estimated 23 million hectares (57 million acres) of wet farmland, including some wetlands, were drained under the U.S. Department of Agriculture's Agricultural Conservation Program between 1940 and 1977 (Office of Technology Assessment, 1984). Some of the wetland-drainage activity was hastened by projects of groups such as the Depression-era WPA (Works Progress Administration) and the Soil Conservation Service (Reilly, 1979). Coastal marshes were eliminated or drained and ditched for intercoastal transportation, residential developments, mosquito control, and even for salt marsh hay production. Interior wetlands were converted primarily to provide land for urban development, road construction, and agriculture.

Typical of the prevalent attitude toward wetlands is the following quote by Norgress (1947) discussing the "value" of Louisiana cypress swamps:

> With 1,628,915 acres of cutover cypress swamp lands in Louisiana at the present time, what use to make of these lands so that the ideal cypress areas will make a return on the investment for the landowner is a serious problem of the future. . . .
>
> The lumbermen are rapidly awakening to the fact that in cutting the timber from their land they have taken the first step toward putting it in position to perform its true function—agriculture. . . .
>
> It requires only a visit into this swamp territory to overcome such prejudices that reclamation is impracticable. Millions of dollars are being put into good roads. Everywhere one sees dredge boats eating their way through the soil, making channels for drainage.
>
> After harvesting the cypress timber crop, the Louisiana lumbermen are at last realizing that in reaping the crop sown by Nature ages ago, they have left a heritage to posterity of an asset of permanent value and service—land, the true basis for wealth.
>
> The day of the pioneer cypress lumberman is gone, but we need today in Louisiana another type of pioneer—the pioneer who can help bring under cultivation the enormous areas of cypress cutover lands suitable for agriculture. It is important to Louisiana, to the South, and the Nation as a whole, that this be done. Would that there were some latter-day Horace Greeleys to cry, in clarion tones, to the young farmers of today, "Go South, young man; go South!"

As an example of state action leading to wetland drainage, Illinois passed the Illinois Drainage Levee Act and the Farm Drainage Act in 1879, which allowed counties to organize into drainage districts to consolidate financial resources. This action accelerated draining to the point that 27 percent of Illinois is now under some form of drainage and almost all of the original wetlands in the state (85 percent) have been destroyed. In Ohio, over 90 percent of the original wetlands were drained, partially assisted and encouraged by the then newly formed land-grant college in Columbus. That college, now The Ohio State University, still houses a "Drainage Hall of Fame."

WETLAND ALTERATION

In a sense, wetland alteration or destruction is an extreme form of wetland management. One model of wetland alteration (Fig. 16–2) assumes that three main factors influence wetland ecosystems: water level, nutrient status, and natural disturbances (Keddy, 1983). Through human activity, the modification of any one of these factors can lead to wetland alteration, either directly or indirectly. For example, a wetland can be disturbed through decreased water levels, as in draining and filling, or through increased water levels, as in downstream drainage impediments. Nutrient status can be affected through upstream flood control that decreases the frequency of nutrient inputs or through increased nutrient loading from agricultural areas.

The most common alterations of wetlands have been (1) draining, dredging, and filling of wetlands; (2) modification of the hydrologic regime; (3) highway construction; (4) mining and mineral extraction; and (5) water pollution. These wetland modifications are described in more detail below.

Wetland Conversion: Draining, Dredging, and Filling

The major cause of wetland loss in the United States continues to be conversion to agricultural use. Figure 16–3 illustrates the steady rate, interrupted by World War II, of drainage for farms since 1900 (Gosselink and Maltby, 1990). Probably about 65 percent of this land was wetland (Office of Technology Assessment, 1984). This conversion was particularly significant in the vast midwestern "breadbasket" that has provided the bulk of the grain produced on the continent

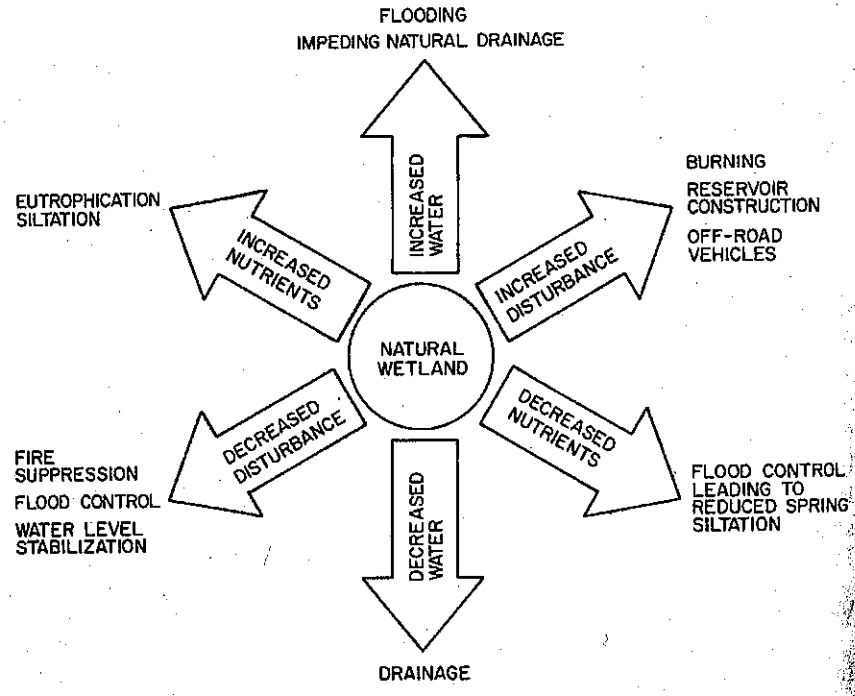


Figure 16–2. Model of human-induced impacts on wetlands, including effects on water level, nutrient status, and natural disturbance. By either increasing or decreasing any one of these factors, wetlands can be altered. (*From Keddy, 1983, copyright © 1983 by Springer-Verlag, reprinted with permission*)

(Fig. 16–4). When drained and cultivated, the fertile soils of the prairie pothole marshes and east Texas playas produce excellent crops. With ditching and modern farm equipment, it has been possible to farm these small marshes.

Since the mid-twentieth century, however, the most rapid changes have occurred in the bottomland hardwood forests of the Mississippi River alluvial floodplain. As the populations increased along the river, the floodplain was channeled and leveed so that it could be drained and inhabited. Since colonial times the floodplain provided excellent cropland, especially for cotton and sugarcane. Cultivation, however, was restricted to the relatively high elevation of the natural river levees, which flooded regularly after spring rains and upstream snowmelts but drained rapidly enough to enable farmers to plant their crops. Because the river levees were naturally fertilized by spring floods, they required no additional fertilizers to grow productive crops. One of the results of drainage and flood protection is the additional cost of fertilization. The lower parts of the floodplain, which are too wet to cultivate, were left as forests but harvested for timber. As pressure for additional cropland increased, these agriculturally marginal forests

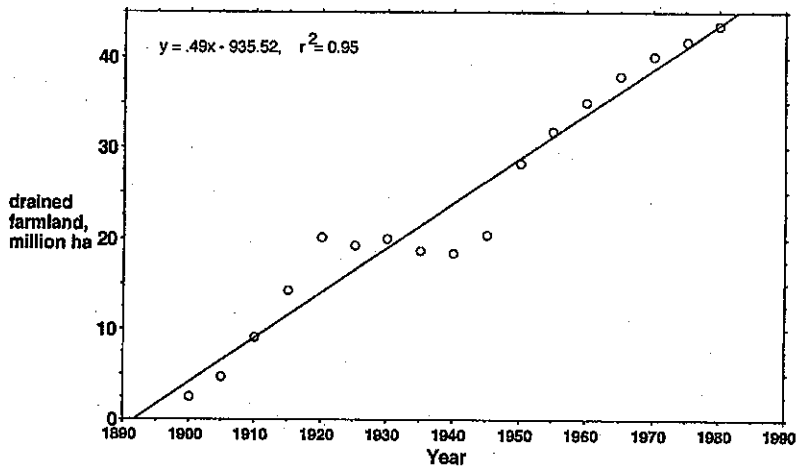


Figure 16–3. Trend of drained farmland in the United States from 1900 to 1980. (*After Gosselink and Maltby, 1990, based on data from Office of Technology Assessment, 1984*)

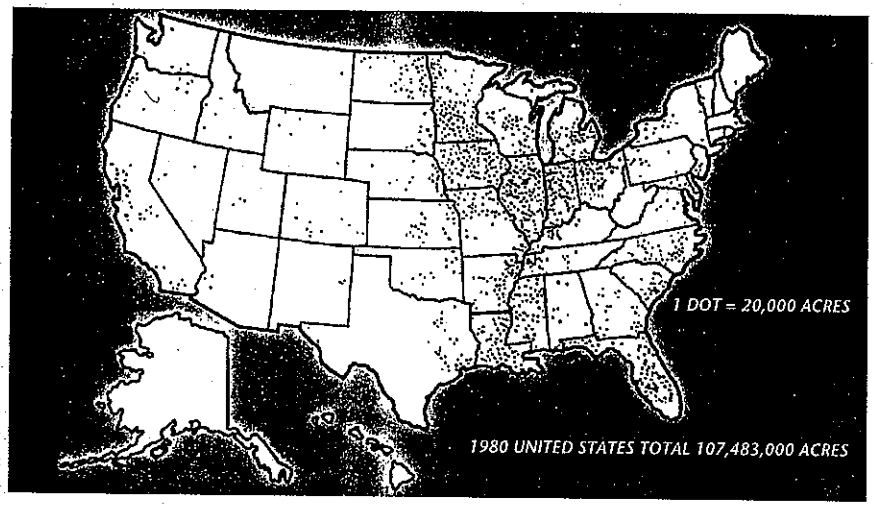


Figure 16–4. Extent and location of artificially drained agricultural land in the United States as of 1985. Each dot represents 8,000 hectares (20,000 acres). (*From Dahl, 1990*)

were clear-cut at an unprecedented rate (Fig. 16–5). This was feasible in part because of the development of soybean varieties that mature rapidly enough to be planted in June or even early July, after severe flooding has passed. Often the land thus "reclaimed" was subsequently incorporated behind flood- control levees where it was kept dry by pumps (Stavins, 1987). Clear-cutting of bottomland forests is still proceeding from north to south. Most of the available wetland has

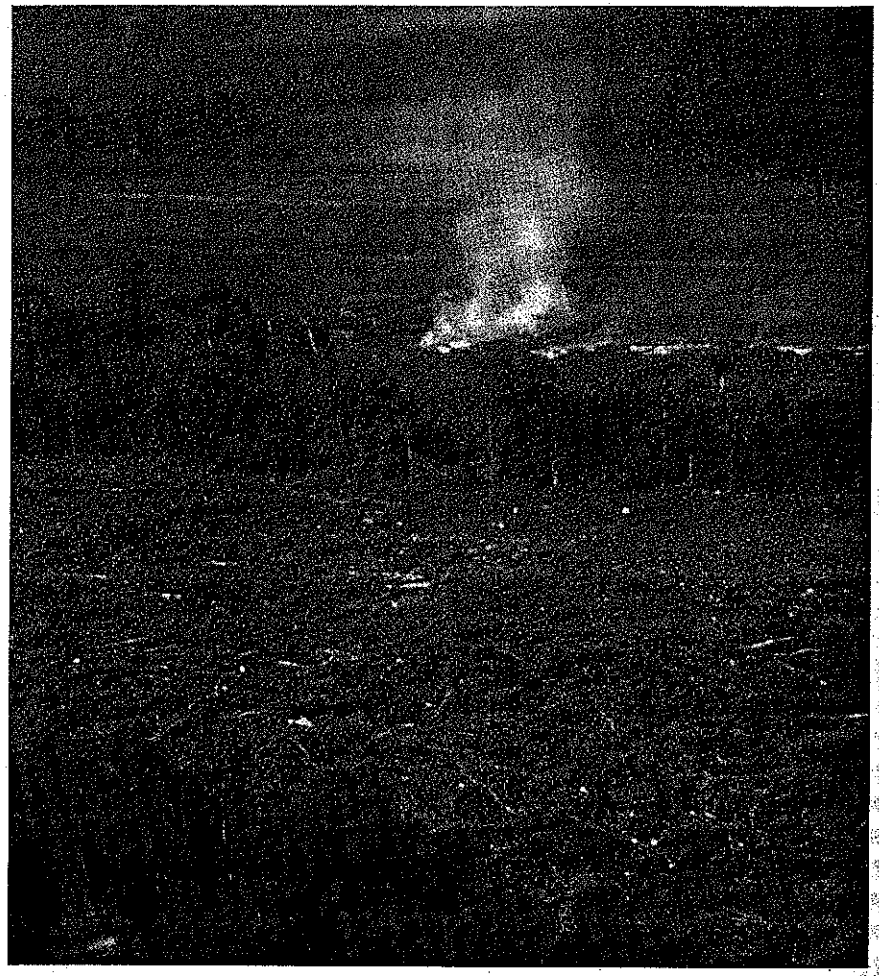


Figure 16–5. Oblique aerial photograph of bottomland in the Tensas River Basin, Louisiana, formerly a 1-million hectare forest. In the foreground, trees have been sheared off and felled with a bulldozer blade. Above, a line of standing trees remains along a slightly wet depression. Above the standing trees, felled trees have been pushed into a line to be burned. In the distance, the cleared land has been harrowed for planting, probably to soybeans. (*Credit: Larry Harper, U.S. Army Corps of Engineers, 1981*)

been converted in Arkansas and Tennessee; Mississippi and Louisiana are experiencing large losses (Fig. 3–9).

Along the nation's coasts, especially the East and West coasts, the major cause of wetland loss is draining and filling for urban and industrial development. Compared to land converted to agricultural use, the area involved is rather small.

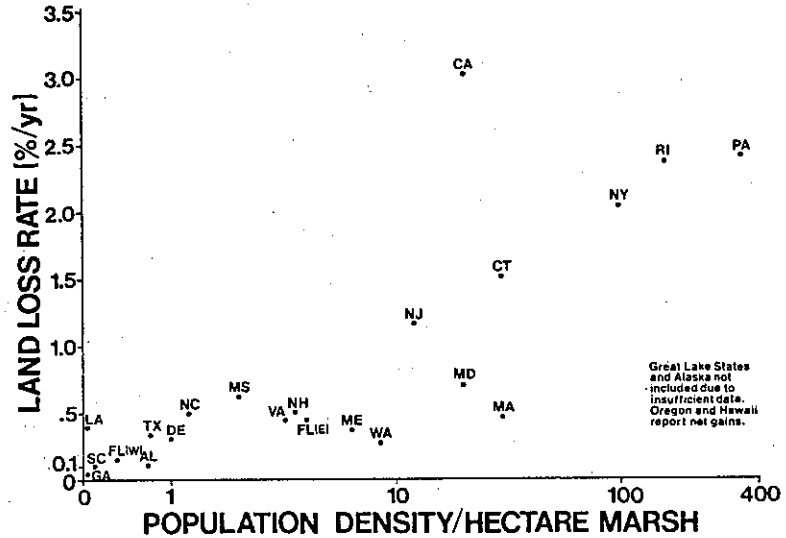


Figure 16–6. Relationship between coastal wetland loss (1954–1974) and population density for coastal counties. (*From Gosselink and Baumann, 1980; copyright © 1980 by Gebruder Borntraeger, reprinted with permission*)

Nevertheless, in some coastal states, notably California, almost all coastal wetlands have been lost. The rate of coastal wetland loss from 1954 to 1974 was closely tied to population density (Fig. 16–6). This finding underscores two facts: (1) two-thirds of the world's population lives along coasts; (2) population density puts great pressure on coastal wetlands as sites for expansion. The most rapid development of coastal wetlands occurred after World War II. In particular, several large airports were built in coastal marshes. Since the passage of federal legislation controlling wetland development, the rate of conversion has slowed.

Hydrologic Modifications

Ditching, draining, and levee building are hydrologic modifications of wetlands specifically designed to dry them out. Other hydrologic modifications destroy or change the character of thousands of hectares of wetlands annually. Usually these hydrologic changes were made for some purpose that had nothing to do with wetlands; wetland destruction is an inadvertent result. Canals, ditches, and levees are created for three primary purposes:

1. *Flood control.* Most of the canals and levees associated with wetlands are for flood control. The canals have been designed to carry floodwaters off the adjacent uplands as rapidly as possible. Normal drainage through wetlands is slow

surface sheet flow; straight, deep canals are more efficient. Ditching marshes and swamps to drain them for mosquito control or biomass harvesting is a special case designed to lower water levels in the wetlands themselves. Along most of the nation's major rivers are systems of levees constructed to prevent overbank flooding of the adjacent floodplain. Most of those levees were built by the U.S. Army Corps of Engineers after Congress passed flood-control legislation after the disastrous floods of the the 1920s and 1930s. Those levees, by separating the river from its floodplain, isolated wetlands so that they could be drained expeditiously. For example, along the lower Mississippi River the creation of levees created a demand from farmers for additional floodplain drainage. The sequence of response and demand was so predictable that farmers bought and cleared floodplain forests in anticipation of the next round of flood-control projects.

2. *Navigation and transportation.* Navigation canals tend to be larger than drainage canals. They traverse wetlands primarily to provide water-transportation access to ports and to improve transport among ports. For example, the Intracoastal Waterway was dredged through hundreds of miles of wetlands in the northern Gulf Coast. In addition, when highways were built across wetlands, fill material for the roadbed was often obtained by dredging soil from along the right-of-way, thus forming a canal parallel to the highway.
3. *Industrial activity.* Many canals are dredged to obtain access to sites within a wetland for the purpose of sinking an oil well, building a surface mine, or other kinds of development. Usually pipelines that traverse wetlands are laid in canals that are not backfilled.

The result of all of these activities can be a wetland crisscrossed with canals, especially in the immense coastal wetlands of the northern Gulf Coast (Fig. 16–7). These canals modify wetlands in a number of ecological ways by changing normal hydrologic patterns. Straight, deep canals in shallow bays, lakes, and marshes capture flow, depriving the natural channels of water. Canals are hydrologically efficient, allowing the more rapid runoff of fresh water than the normal shallow, sinuous channels do. As a result, water levels fluctuate more rapidly than they do in unmodified marshes, and minimum levels are lowered, drying the marshes. The sheet flow of water across the marsh surface is reduced by the spoil banks that almost always line a canal and by road embankments that block sheet flow. Consequently, the sediment supply to the marsh is reduced, and the water on the marsh is more likely to stagnate than when freely flooded. In addition, when deep, straight channels connect low-salinity areas to high-salinity zones, as with many large navigation channels, tidal water, with its salt, intrudes farther upstream, changing freshwater wetlands to brackish. In extreme cases, salt-intolerant vegetation is killed and is not replaced before the marsh erodes into a shallow lake. On the Louisiana coast the natural subsidence rate is high; wetlands go through a natural cycle of growth followed by decay to open bodies of water.

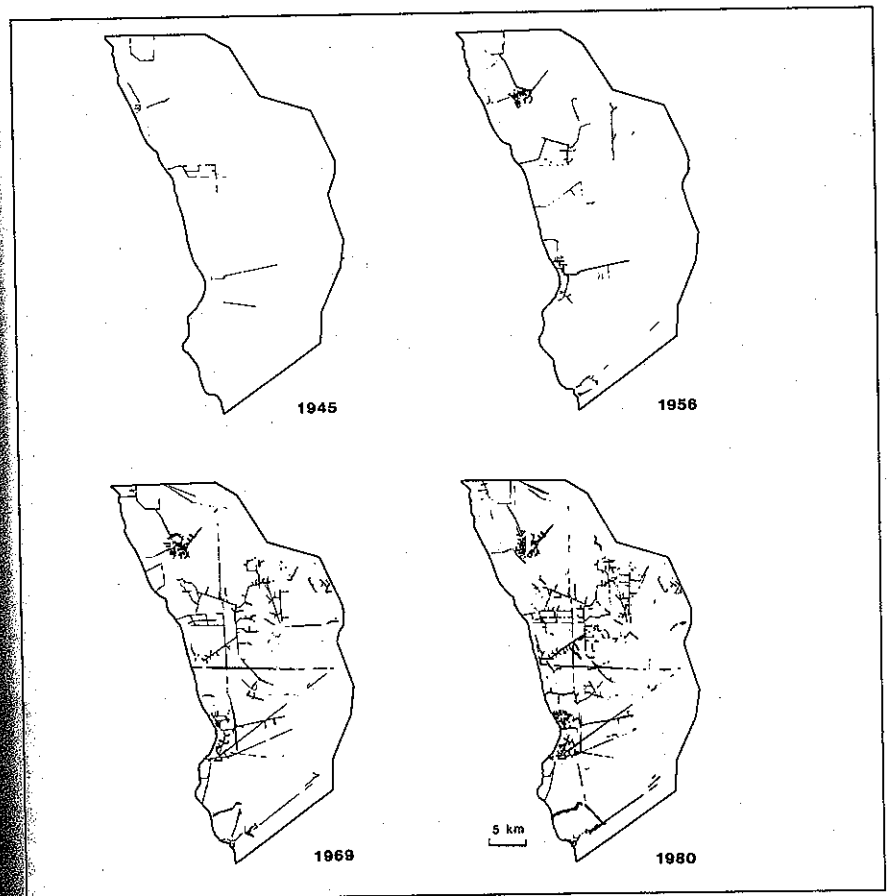


Figure 16–7. Computer images showing growth in the number and length of navigational canals constructed in the wetlands of the north central coast of the Gulf of Mexico (Barataria Bay, Louisiana) from 1945 to 1980. The concentrated nodes of canals are sites of oil fields. Each short canal segment provides access to an oil well. (*From Sasser et al., 1986; copyright © 1986 by Springer Verlag, New York, reprinted with permission*)

These canals accelerate the subsidence rate by depriving wetlands of natural sediment and nutrient subsidies.

Highway Construction

Highway construction can have a major effect on the hydrologic conditions of wetlands (see Fig. 16–8). Although few definitive studies have been able to document the extent of wetland damage caused by highways (Adamus, 1983), several studies have inferred that the major effects of highways are alteration of the

Figure 16–8. This sign is typical of the conflict between wetland protection and highway construction. Sign was near a proposed highway in central Florida. (*Photograph by W. J. Mitsch*)

hydrologic regime, sediment loading, and direct wetland removal. McLeese and Whiteside (1977) compared the effects of highways on uplands and wetlands in Michigan and found that wetlands were much more sensitive to highway construction than uplands were, particularly through the disruption of hydrologic conditions. Similarly, Clewell et al. (1976) and Evink (1980) found that highway construction in Florida led to negative effects on coastal wetlands through hydrologic isolation. The authors of the former study discovered that isolated tidal marshes became less saline and began to fill with vegetation because of the construction of a filled roadway. The authors of the latter study found that the decreased circulation that resulted from a causeway increased nutrient retention in the wetland and led to subsequent symptoms of eutrophication. Adamus (1983) concluded that the "best location for a highway that must cross a wetland is one which minimizes interference with the wetland ecosystem's most important dri-

ving forces." Other than solar energy and wind, the most important driving forces for wetlands are hydrologic, including tides, gradient currents (e.g., streamflow), runoff, and groundwater flow. The importance of protecting the hydrologic regime during highway construction is based on the contention presented in Chapter 4 that the hydrology of wetlands is the most important determinant of a wetland's structure and function.

Peat Mining

Surface peat mining has been a common activity in several European countries, particularly the lands of the former Soviet Union, since the eighteenth century. That territory accounts for almost 90 percent of peat mining in the world; most of the material derived from that process is used as a fuel for electric power production (Moore and Bellamy, 1974). In the United States, peat resources are estimated at about 63 billion tons (Table 16–1). Since its inception peat mining in the United States has been primarily undertaken for agricultural and horticultural uses and has been done on a relatively small scale. Approximately 825,000 tons of peat were mined in the United States in 1979; 77 percent came from the states of Michigan, Florida, Illinois, Indiana, and New York, in decreasing order (Carpenter and Farmer, 1981). More recent data (Table 16–1) suggest a decrease of peat mining to about 480,000 tons per year in the United States and even less (290,000 tons/yr) in Canada. Almost all of that peat was used for horticultural purposes. Mining for energy production is often proposed on a large scale for the peatlands in Minnesota and the pocosins in North Carolina. It has been estimated that Minnesota has enough peat reserves to supply its energy needs for 32 years (Williams, 1990).

Mineral and Water Extraction

Surface mining activity for materials other than peat often affects major regions of wetlands. Phosphate mining in central Florida has had a significant impact on wetlands in the region (Gilbert et al., 1981; Dames and Moore, 1983; M. T. Brown et al., 1992). Thousands of hectares of wetlands may have been lost in central Florida because of this activity alone, although the reclamation of phosphate-mined sites for wetlands is now a common practice (see Chap. 17). H. T. Odum et al. (1981) argued that "managed ecological succession" on mined sites could be an economical alternative to such expensive techniques moving earth and reclamation planting.

Surface mining of coal has also affected wetlands in some parts of the country (Brooks et al., 1985). Mitsch et al. (1983b, c) identified 46,000 hectares of wetlands, mostly bottomland hardwood forests, that could be or are being affected by surface coal mining in western Kentucky alone, whereas Cardamone et al. (1984)

Table 16–1. Estimated Reserves and Peat Production in the World

Country	Reserve, x 10^6 tons[a]	Peat Production, x 10^3 tons/yr		
		Fuel	Horticulture	Total
Former USSR	120,000	48,000	72,000	120,000
Finland	6,240	4,054	279	4,333
Ireland	2,459	3,646	196	3,842
China	27,000	480	780	1,260
Former FRG	133	170	1,077	1,247
Sweden	11,000	770	1,077	1,247
USA	62,985	—	480	480
Burundi	109	480	—	480
United Kingdom	1,500	—	370	370
Former GDR	—	—	315	315
Canada	335,000	—	294	294
Poland	1,914	—	178	178
Czecholovakia	78	—	157	157
France	—	30	60	90
Denmark	—	—	88	88
Venezuela	—	—	60	60
Norway	2,000	1	50	51
New Zealand	—	0	6	6
Other countries	132,567	—	—	—
Total	703,021[b]	57,631	76,600	134,231

[a]ton = metric ton (mt)
[b]Approximately half of total world pool of soil carbon 1,400,000 x 10^6 ton (Post et al., 1982)
Source: Based on Immirzi et al., 1992

prescribed methods available to protect wetlands during mining or to create wetlands as part of the reclamation process (Fig. 16–9). The recognition of the potential benefits of including wetlands as part of the reclamation of coal mines has not been as widespread as one would have expected because of the strict interpretation of measures regulating the return of the land to its original contours and because of liability questions. This is in contrast to the widespread acceptance of the reclamation of wetlands on phosphorus mine sites in Florida.

In some parts of the country, the withdrawal of water from aquifers or minerals from deep mines has resulted in accelerated subsidence rates that are lowering the elevations of marshes and built-up areas alike, sometimes dramatically. For example, groundwater and mineral extraction has led to as much as 2.5 m of subsidence in northern Galveston Bay (Kreitler, 1977). Land subsidence, which can also result in the creation of lakes and wetlands, is a geologically common phenomenon in Florida. Often when excessive amounts of water are removed from the ground, underground cave-ins occur in the limestone, causing surface slumpage. Some believe that the cypress domes in north-central Florida are an indirect result of a similar natural process whereby fissures and dissolutions of underground limestone cause slight surface slumpage and subsequent wetland development.

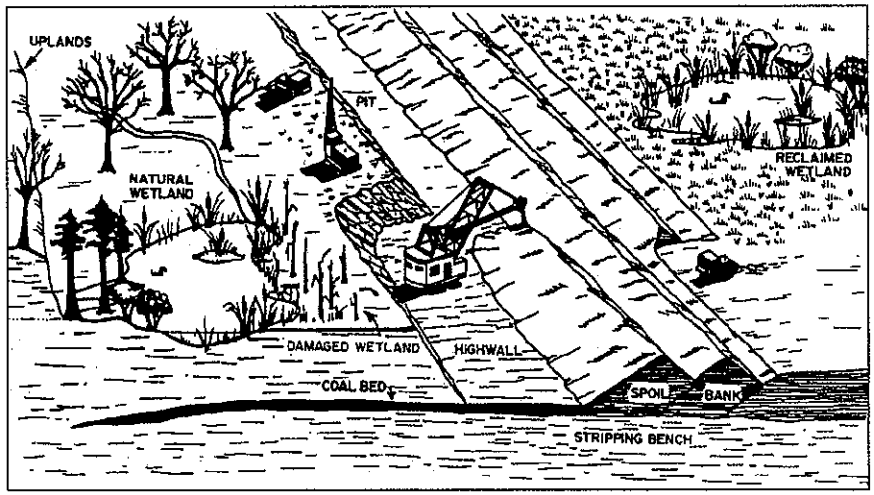


Figure 16–9. Possible use of wetlands in reclamation of coal surface mines for wildlife enhancement and for control of mine drainage. (*From Cardamone et al., 1984*)

Water Pollution

Wetlands are altered by pollutants from upstream or local runoff and, in turn, change the quality of the water flowing out of them. The ability of wetlands to cleanse water has received much attention in research and development and is discussed elsewhere (see Chapters 15 and 17 and Water Quality Management section in this chapter). The effects of polluted water on wetlands has received less attention, although there is discussion now in the United States about establishing water-quality standards for wetlands (Robb, 1992; Nichols, 1992). Many coastal wetlands are nitrogen limited; one response to nitrogen as one of the pollutants is increased productivity of the vegetation and increased standing stocks of vegetation followed by increased rates of decay of the vegetation, at least initially, and higher community respiration rates. Species composition may also change with eutrophication of wetlands. For example, increased agricultural runoff, laden with phosphorus, is believed to have caused a spread of *Typha* spp. in conservation areas that are part of the original Everglades in Florida (Koch and Reddy, 1992; Gunderson and Loftus, 1993). This, in turn, has increased fears that the phosphorus will eventually lead to invasion of *Typha* in the Everglades National Park itself replacing the natural sawgrass (*Cladium jamaicense*).

When metals or toxic organic compounds are pollutants, effects on the wetland can be dramatic. In severe cases of water pollution, wetland vegetation can be killed, as occurred when oil was spilled on a coastal marsh (J. M. Baker, 1973) or sulfates were discharged into a forested wetland (J. Richardson et al., 1983). Acid drainage from active and abandoned coal mines has been shown to affect wetlands seriously. Mitsch et al. (1983a, b, c) documented the presence of wet-

lands and coal surface mining adjacent to each other in western Kentucky. In many instances, waters with low pH and high iron and sulfur were discharged from these mines into or through wetlands, causing extensive ecological damage (Fig. 16–10).

In one of the most publicized and dramatic cases of water pollution of a wetland, selenium from farm runoff contaminated marshes in Kesterson National Wildlife Refuge in California's San Joaquin Valley (Presser and Ohlendorf, 1987; T. Harris, 1991). The selenium contamination led to excessive death and deformities of wildlife and to eventual "closing" of the contaminated marsh in the mid-1980s amid much controversy.

WETLAND MANAGEMENT BY OBJECTIVE

Wetlands are managed for environmental protection, for recreation and aesthetics, and for the production of renewable resources. Stearns (1978) lists 12 specific goals of wetland management: that are applicable today:

1. maintain water quality
2. reduce erosion
3. protect from floods
4. provide a natural system to process airborne pollutants
5. provide a buffer between urban residential and industrial segments to ameliorate climate and physical impact such as noise
6. maintain a gene pool of marsh plants and provide examples of complete natural communities
7. provide aesthetic and psychological support for human beings
8. produce wildlife
9. control insect populations
10. provide habitats for fish spawning and other food organisms
11. produce food, fiber, and fodder; for example, timber, cranberries, cattails for fiber
12. expedite scientific inquiry

One excellent management decision is to fence in a wetland to preserve it. Although simple, this is an act of conservation of a valuable natural ecosystem involving no substantative changes in management practices. Often, however, management has one or more specific objectives that require positive manipulation of the environment. Efforts to maximize one objective may be incompatible with the attainment of others, although in recent years most management objectives have been broadly stated to enhance a broad range of objectives. Multipurpose management generally focuses on system-level support rather than individual species. This has often been achieved indirectly through plant species manipulation because plants provide food and cover for the animals (Weller,

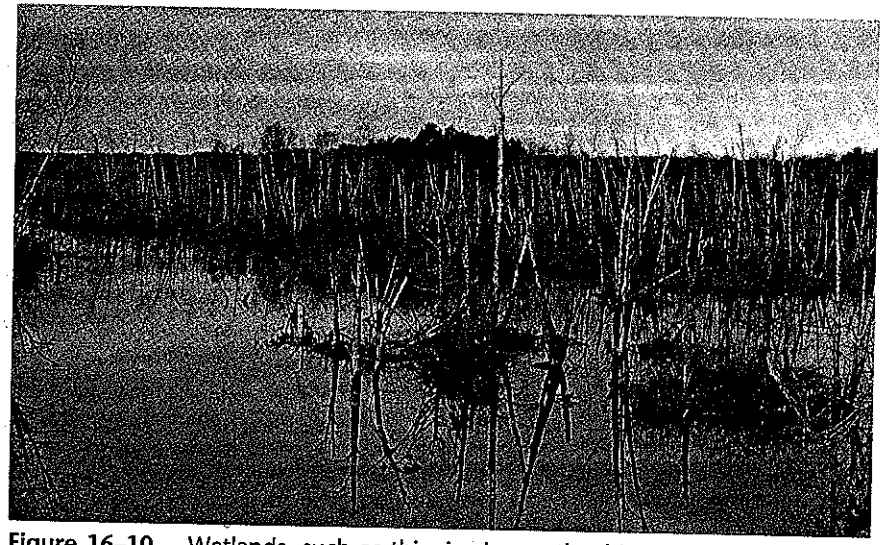
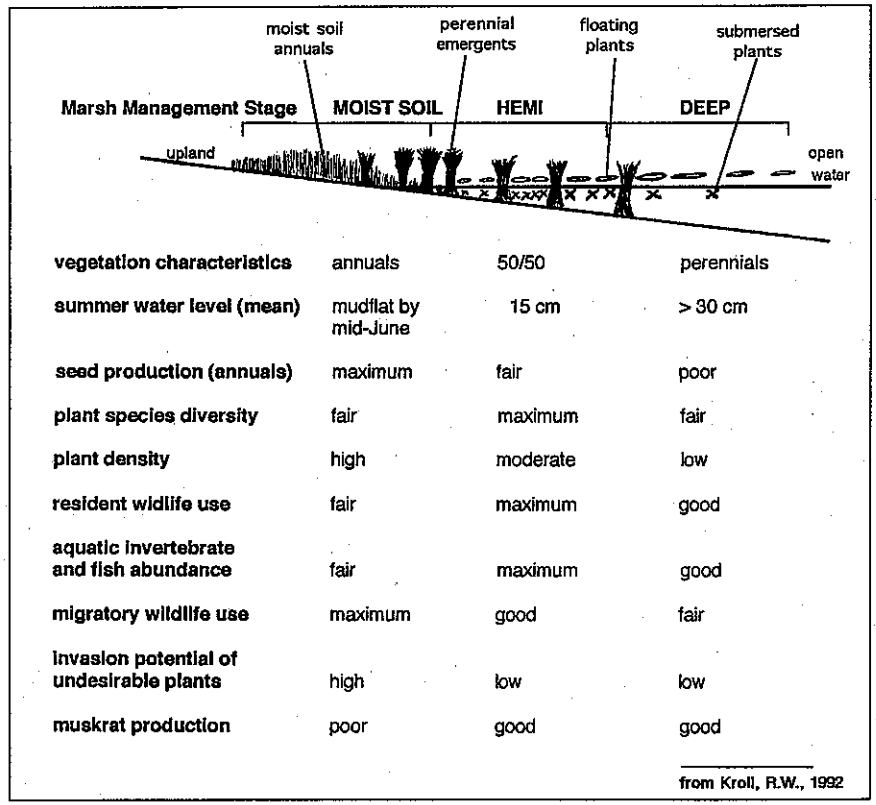


Figure 16–10. Wetlands, such as this riverine wetland impacted by coal mine drainage in western Kentucky, can be negatively affected by water pollution. (*Photograph by W. J. Mitsch*)

1978). When many small wetland management areas are in close proximity, different practices should be used, or the management cycle should staggered so that the different areas are not all treated the same way at the same time. Implementing a strategy of this kind would not only increase the diversity of the larger landscape but would also be attractive to wildlife.

Wildlife Enhancement

The best wetland management practices are those that enhance the natural processes of the wetland ecosystem involved. One way to accomplish this is to maintain conditions as close as possible to the natural hydrology of the wetland, including hydrologic connections with adjacent rivers, lakes, and estuaries. Unfortunately, this cannot easily be accomplished in wetlands managed for wildlife; the vagaries of nature, especially in hydrologic conditions, make planning difficult. Hence marsh management for wildlife in North America, particularly waterfowl, has often meant water level manipulation. Water level control is achieved by dikes (impoundments), weirs (solid structures in marsh outflows that maintain a minimum water level), control gates, and pumps. In general, the results of the management activity depend on how well the water level control is maintained, and control depends on the local rainfall and on the sophistication of the control structures. For example, weirs provide the poorest control; all they do is maintain a minimum water level. Pumps provide positive control of drainage or flooding depth at the desired time; and the management objectives can usually be met (Wicker et al., 1983).



vegetation characteristics	annuals	50/50	perennials
summer water level (mean)	mudflat by mid-June	15 cm	> 30 cm
seed production (annuals)	maximum	fair	poor
plant species diversity	fair	maximum	fair
plant density	high	moderate	low
resident wildlife use	fair	maximum	good
aquatic invertebrate and fish abundance	fair	maximum	good
migratory wildlife use	maximum	good	fair
invasion potential of undesirable plants	high	low	low
muskrat production	poor	good	good

from Kroll, R.W., 1992

Figure 16–11. Some generalizations of water level management for vegetation, wildlife use, and other characteristics as practiced on impounded marshes near Lake Erie in northern Ohio. (*Redrawn from R. Kroll, Winous Point Shooting Club, Port Clinton, Ohio, 1992, with permission*)

To illustrate the trade-offs in wetland management for wildlife enhancement, some generalizations about water-level manipulation for the Lake Erie (Ohio) coastal marshes are shown in Figure 16–11. Maximum migratory wildlife use of the marshes happens in moist soil conditions, but these conditions are also the best for the invasion of potentially undesirable plants and are generally least favorable for the overall abundance and diversity of resident plant and animal populations. Shallow water (hemi) conditions (around 15 cm depth in summer) usually result in the highest plant species diversity and greatest fish and resident wildlife use but less migratory wildlife. Deep water conditions (>30 cm) offer the least potential for both annual emergent plants and invading, undesirable plants, but desirable migratory waterfowl use is only fair in deep water.

The set of management recommendations by Weller (1978) for prairie pothole marshes in the north-central United States and south-central Canada are other examples of multipurpose wildlife enhancement. Those practices mimic the natural cycle of the marshes (see Chap. 11). Although they may seem drastic, they are entirely natural in their consequences. In sequence, the practices are as follows:

1. When a pothole is in the open stage and there is little emergent vegetation, the cycle should be initiated by a spring drawdown. This stimulates the germination of seedlings on the exposed mud surfaces.
2. A slow increase in water level after the drawdown maintains the growth of flood-tolerant seedlings without shading them out in turbid water. Shallowly flooded areas attract dabbling ducks during the winter.
3. The drawdown cycle should be repeated for a second year to establish a good stand of emergents.
4. Low water levels should be maintained for several more seasons to encourage the growth of perennial emergents such as cattails.
5. Maintaining stable, moderate water depths for several years promotes the growth of rooted submerged aquatic plants and associated benthic fauna that make excellent food for waterfowl. During that period, the emergent vegetation will gradually die out and will be replaced by shallow ponds. When that occurs, the cycle can be initiated again, as described in (1) above.
6. Different wetland areas maintained in staggered cycles provide all stages of the marsh cycle at once, maximizing habitat diversity.

Wildlife management in coastal salt marshes such as those found in Louisiana uses a similar strategy, although the short-term cycle is not as pronounced there. Drawdowns to encourage the growth of seedlings and perennials preferred by ducks is a common practice, as is fall and winter flooding to attract dabbling ducks. As it happens, there is general agreement that stabilizing water levels is not good management, even though our society seems to feel intuitively that stability is a good thing. Wetlands thrive on cycles, especially flooding cycles, and practices that dampen these cycles also reduce wildlife productivity. Although the management practices described above enhance waterfowl production, they are generally deleterious for wetland-dependent fisheries in coastal wetlands since free access between the wetlands and the adjacent estuary is restricted; the wetlands' role in regulating water quality is also often underutilized.

Agriculture and Aquaculture

When wetlands are drained for agricultural use, they no longer function as wetlands. They are, as the local farmer says, "fast lands" removed from the effects of periodic flooding and they grow terrestrial, flood-intolerant crops. Some use is made of more or less undisturbed wetlands for agriculture, but it is minor. In New England high-salt marshes were harvested for "salt marsh hay" that was considered an excellent bedding and fodder for cattle. In fact, Russell (1976) stated that

the proximity of fresh and salt hay marshes was a major factor in selecting the sites for the emergence of many towns in New England before 1650. Subsequently, marshes were ditched to allow the intrusion of tides to promote the growth of salt marsh hay (*Spartina patens*), but the extent of this practice has not been well documented. On the coast of the Gulf of Mexico where coastal marshes are firm underfoot, they are still used extensively for cattle grazing. To improve access, small embankments or raised earthen paths are constructed in those marshes.

The ancient Mexican practice of *marceno* is unique. In the freshwater wetlands of the northern coast of Mexico, small areas were cleared and planted in corn during the dry season. Those native varieties were tolerant enough to withstand considerable flooding. After harvest (or apparently sometimes before harvest), the marshes were naturally reflooded, and the native grasses were reestablished until the next dry season. This practice is no longer followed, but there has been some interest in reviving it (Orozco-Segovia, 1980).

Aquaculture usually requires more extensive manipulation of the environment than the practices mentioned above. When ponds are constructed with retaining walls or levees and pumps, little resemblance to the natural ecosystem remains. Nevertheless, attempts have been made to use estuarine-wetland areas in a more or less natural state to raise fish and shellfish. The practice with shrimp is typical. A natural marsh and pond area is enclosed by weirs, gates, or other water-control structures. Fine mesh fences allow water flux but still retain the cultured animals. Recruitment of postlarval juveniles to the aquaculture site usually occurs naturally, after which the area is sealed off and the shrimp are allowed to grow. They are harvested as they emigrate over the weirs or by seining or trawling within the enclosure. In the southern United States several commercial ventures were launched during the 1970s. None succeeded. There were too many uncertainties, including stock recruitment and predator and disease control. Historically in the United States, coastal fisheries have been considered public resources. The practice of "privatizing" coastal wetlands for shrimp culture, therefore, faces serious legal challenges.

A more successful commercial venture is crayfish farming in combination with timber production. Crayfish are an edible delicacy in the southern United States and in many foreign countries. They live in burrows in shallow flooded areas such as swamp forests and rice fields, emerging with their young early in the year to forage for food. The young grow to edible size within a few weeks and are harvested in the spring. When floodwaters retreat, the crayfish construct burrows where they remain until the next winter flood. In crayfish farms this natural cycle is enhanced by controlling water levels. An area of swamp forest is impounded; it is flooded deep during the winter and spring and drained during the summer. This cycle is ideal for crayfish, which thrive. Fish predators are controlled within the impoundments to improve the harvest. The hydrologic cycle is also favorable for forest trees. It simulates the hydrologic cycle of a bottomland hardwood forest; forest tree productivity is high, and seedling recruitment is good

Figure 16–12. Rice cultivation is an important agricultural wetland management practice throughout the world. This photo, taken in the Yangtze River Valley of China near Nanjing, shows typical rice plants being tilled early in the growing season while water is being added to the fields. (*Photo by W. J. Mitsch*)

because of the summer drawdown. Species composition tends toward species typical of bottomland hardwoods (Conner et al., 1981).

On a global scale, of course, the production of rice in managed wetlands contributes a major proportion of the world's food supply (Fig. 16–12). Aselmann and Crutzen (1989) estimated that there are approximately 1.3 million km^2 of rice paddies in the world, of which almost 90 percent are in Asia. In North America, especially in Minnesota, there are several commercial operations in the production of wild rice (*Zizania aquatica*) in wetlands.

Some rice farmers have also found that they can take advantage of the same annual flooding cycle to combine rice and crayfish production. Rice fields are drained during the summer and fall when the rice crop matures and is harvested. Then the fields are reflooded, allowing crayfish to emerge from their burrows in the rice field embankments and forage on the vegetation remaining after the rice harvest. The crayfish harvest ends when the fields are replanted with rice. When this rotation is practiced, extreme care has to be exercised in the use of pesticides.

Water Quality Enhancement

A number of studies have shown natural wetlands to be sinks for certain chemicals, particularly sediments and nutrients (see Chaps. 5 and 17). It is now com-

mon to cite the water quality role of natural wetlands in the landscape as one of the most important reasons for the protection (Fig. 16–13). The idea of applying domestic, industrial, and agricultural wastewaters, sludges, and even urban and rural runoff to wetlands to take advantage of this nutrient-sink capacity has also been explored. Many wetland treatment systems are summarized by Nichols (1983), Godfrey et al. (1985), Hammer (1989), and Cooper and Findlater (1990) and are discussed in Chapter 17. To some the idea involves wastewater treatment, to others wastewater disposal. Regardless of what it is called, wastewater recycling in wetlands is an intriguing concept involving the forging of a partnership between humanity and the ecosystem.

Much of the interest in maintaining the natural wetlands for water quality management purposes was sparked by two studies begun in the early 1970s. In one of those studies northern peatlands at Houghton Lake and other communities in Michigan were investigated by researchers from the University of Michigan for the wetlands's capacity to treat wastewater (see Richardson et al., 1978; Kadlec, 1979; Kadlec and Kadlec, 1979; Kadlec and Tilton, 1979; Tilton and

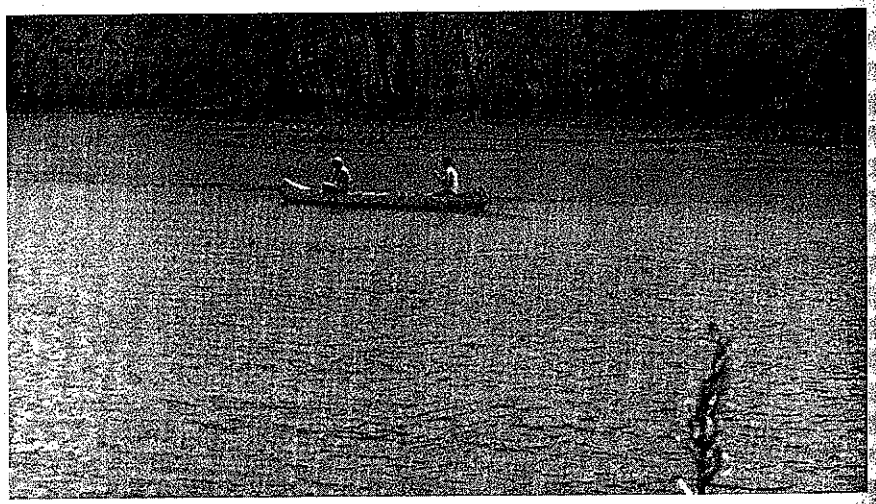


Figure 16–13. Natural wetlands, when left as major parts of the landscape, often provide water quality roles in their natural condition without much human management. In this photo, two colors of water are noted, with the dividing line approximately at the canoe. The water in the foreground is highly polluted with sediments from a watershed artificially drained by a large ditch. The clearer water in the background is from a flooding river that is passing through a natural riparian wetland. The forested wetland, with water among the trees, can be seen in the background. Picture was taken during flooding conditions on the Kankakee River near Momence, Illinois, during a typical spring flood in this river. (*Photo by W. J. Mitsch*)

Kadlec, 1979). A pilot operation for disposing of up to 380 m^3 per day (100,000 gallons per day) of secondarily treated wastewater in a rich fen at Houghton Lake led to significant reductions in ammonia nitrogen and total dissolved phosphorus as the water passed from the point of discharge. Inert materials such as chloride did not change as the wastewater passed through the wetland (Kadlec, 1979). An estimated 70 percent of ammonia nitrogen, 99 percent of nitrite and nitrate nitrogen, and 95 percent of total dissolved phosphorus were removed from the wastewater as it passed through the wetland. In 1978 the flow was increased to approximately 5,000 m^3 per day over a much larger area. Data after more than 10 years of operation at this high flow show that although the area of influence of the wastewater on the peatland has grown from 10 to 66 hectares, the effectiveness of the wetland in removing both ammonia-nitrogen and total phosphorus remained extremely high (Knight, 1990).

In a second major research effort in the 1970s to investigate water quality management in natural wetlands, wastewater was applied to several cypress domes in north-central Florida by a team of researchers from the University of Florida (Ewel, 1976; H. T. Odum et al., 1977a; Ewel and Odum, 1978, 1979, 1984). After five years of experimentation in which secondarily treated wastewater was added to the cypress domes at a rate of approximately 2.5 cm/wk (1 in/week), the results indicated that the wetland filtered nutrients, heavy metals, microbes, and viruses from the water. The productivity of the canopy pond cypress trees also increased (Nessel et al., 1982; Lemlich and Ewel, 1984). The uptake of nutrients in these systems was enhanced by a continuous cover of duckweed on the water, by the retention of nutrients in the cypress wood and litter, and by the adsorption of phosphorus onto clay and organic peat in sediments.

Wetlands that have received wastewater for a relatively long time have also been studied. Study sites have included freshwater marshes in Wisconsin (Spangler et al., 1977; Fetter et al., 1978) and forested wetlands in Florida (Boyt et al., 1977; Nessel, 1978a, b; Nessel and Bayley, 1984). All of these studies and several others have demonstrated that wetlands can serve as sinks of nutrients for several years, although their assimilation capacity can become saturated for certain chemical constituents (Kadlec and Kadlec, 1979; Richardson, 1985).

There can be other long-term benefits of using wetlands for water quality management. In the subsiding environment of Louisiana's Gulf Coast, nutrients are permanently retained in peat of wetlands receiving high nutrient wastewater as the wetland aggrades to match subsidence. In this case, wastewater discharge into a wetland can occur without saturating the system and simultaneously helps counteract the deleterious effects of subsidence (Conner and Day, 1989).

The U.S. Environmental Protection Agency (1983) summarized a number of critical technical and institutional considerations "that may act independently or jointly to influence the feasibility of using wetlands as a wastewater management alternative." Although recent policy is to discourage the use of natural wetlands as

wastewater-treatment systems (Olson, 1992), these considerations are useful guides for managing wetlands for any water quality role. They include the following:

Technical Considerations

1. Other values of the wetlands such as wildlife habitat should be considered.
2. Acceptable pollutant and hydrologic loadings must be determined for the use of wetlands in wastewater management.
3. All existing wetland characteristics, including vegetation, geomorphology, hydrology, and water quality, should be well understood.
4. Site-specific analyses of wetlands, particularly as to whether they are hydrologically open or isolated, are necessary to determine their potential for wastewater management. Hydrologically isolated wetlands are likely to be altered if wastewater is applied to them, but hydrologically open wetlands are more likely to affect downstream systems.

Institutional Considerations

5. Potential conflicts over the protection and use of wetlands may arise among state agencies, federal agencies, and local groups.
6. Wastewater disposal into wetlands can often serve the dual purposes of both wetland protection and use, particularly when wetland restoration is involved.
7. State and municipal governments may be liable for damage to private wetlands from wastewater disposal. It is best for appropriate levels of government to obtain ownership or legal control of wetlands that are used for wastewater management.
8. Federal permit processes, many of which are now administered by state agencies, do not recognize wetland-disposal systems. The modification of requirements for granting permits is needed to make use of this effective method of wetland and wastewater management.

Flood Control and Groundwater Recharge

Wetlands can be managed, often passively, for their role in the hydrologic cycle. These hydrologic functions include streamflow augmentation, groundwater recharge, water supply potential, and flood protection (see Chap. 15). It is not altogether clear how well wetlands carry out these functions, nor do all wetlands perform these functions equally well. It is known, for example, that wetlands do not necessarily always contribute to low flows or recharge groundwater (Carter et al., 1979; Verry and Boelter, 1979; Carter, 1986). Some wetlands, however, should be and often are protected for their ability to hold water and slowly return it to surface and groundwater systems in periods of low water. If wetlands are impounded to retain even more water from flooding downstream areas, considerable changes in vegetation will result as the systems adapt to the new hydrologic conditions.

LEGAL PROTECTION OF WETLANDS IN THE UNITED STATES

In the early 1970s interest in wetland protection increased significantly as scientists began to identify and quantify the many values of these ecosystems. This interest in wetland protection began to be translated at the federal level in the United States into laws and public policies. Prior to this time, federal policy on wetlands was vague and often contradictory. Policies in agencies such as the U.S. Army Corps of Engineers, the Soil Conservation Service, and the Bureau of Reclamation encouraged the destruction of wetlands, whereas policies in the Department of Interior, particularly in the U.S. Fish and Wildlife Service, encouraged their protection (Kusler, 1983). Some states have also developed inland and coastal wetland laws and policies, and activity in that area appears to be increasing.

Federal Government Policies and Laws

Some of the more significant activities of the federal government that led to a more consistent wetland protection policy have included presidential orders on wetland protection and floodplain management, implementation of a dredge-and-fill permit system to protect wetlands, coastal zone management policies, and initiatives and regulations issued by various agencies. The primary wetland protection mechanisms used by the federal government are summarized in Table 16–2. Despite all of this activity related to federal wetland management, two major points are still in effect today and should be emphasized:

1. *There is no specific national wetland law.* Wetland management and protection result from the application of many laws intended for other purposes. Jurisdiction over wetlands has also been spread over several agencies, and, overall, federal policy continually changes and requires considerable interagency coordination.
2. *Wetlands have been managed under regulations related to both land use and water quality.* Neither of these approaches, taken separately, can lead to a comprehensive wetland policy. The regulatory split mirrors the scientific split noted by many wetland ecologists, a split that is personified by people who have developed expertise in either aquatic or terrestrial systems. Rarely do individuals possess expertise in both areas.

Early Presidential Orders

President Jimmy Carter issued two executive orders in May 1977 that established the protection of wetlands and riparian systems as the official policy of the federal government. Executive Order 11990, Protection of Wetlands, required all federal agencies to consider wetland protection as an important part of their policies:

Table 16–2. Major Federal Laws, Directives, and Regulations Used for the Management and Protection of Wetlands

Directive or Statute	*Date*	*Responsible Federal Agency*
Rivers and Harbors Act	1899	Army Corps of Engineers
Fish and Wildlife Coordination Act	1967	Fish and Wildlife Service
Land and Water Conservation Fund Act	1968	Fish and Wildlife Service, Bureau of Land Management, Forest Service, National Park Service
Federal Water Pollution Control Act (PL 92-500) as Amended (Clean Water Act)	1972, 1982	
Section 404—Dredge-and-Fill Permit Program		Army Corps of Engineers with assistance from Environmental Protection Agency and U.S. Fish and Wildlife Service
Section 208—Areawide Water Quality Planning		Environmental Protection Agency
Section 303—Water Quality Standards		Environmental Protection Agency
Section 401—Water Quality Certification		Environmental Protection Agency (with state agencies)
Section 402—National Pollutant Discharge Elimination System		Environmental Protection Agency (or state agencies)
Coastal Zone Management Act	1972	Office of Coastal Zone Management, Department of Commerce

continued on next page

> Each agency shall provide leadership and shall take action to minimize the destruction, loss or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands in carrying out the agency's responsibilities for (1) acquiring, managing, and disposing of Federal lands and facilities; and (2) providing federally undertaken, financed, or assisted construction and improvement; and (3) conducting Federal activities and programs affecting land use, including but not limited to water and related land resources planning, regulating, and licensing activities.

Executive Order 11988, Floodplain Management, established a similar federal policy for the protection of floodplains, requiring agencies to avoid activity in the floodplain wherever practicable. Furthermore, agencies were directed to revise

Table 16–2 continued

Directive or Statute	*Date*	*Responsible Federal Agency*
Flood Disaster Protection Act	1973, 1977	Federal Emergency Management Agency
Federal Aid to Wildlife Restoration Act	1974	Fish and Wildlife Service
Water Resources Development Act	1976, 1990	Army Corps of Engineers
Executive Order 11990 Protection of Wetlands May	1977	All agencies
Executive Order 11988 Floodplain Management	May 1977	All agencies
Food Security Act, Swampbuster provisions	1985	U.S. Dept. Agriculture, Soil Conservation Service
Emergency Wetland Resources Act	1986	Fish and Wildlife Service
Wetland Delineation Manuals (various revisions)	1987, 1989, 1991	All agencies
North American Wetlands Conservation Act	1989	Fish and Wildlife Service
"No Net Loss" Policy	1988	All agencies
Wetlands Reserve Program	1991	U.S. Dept. Agriculture, Soil Conservation Service

Source: Based on data from Kusler, 1983; Environmental Defense Fund and World Wildlife Fund, 1992; Want, 1990

their procedures to consider the impact that their activities might have on flooding and to avoid direct or indirect support of floodplain development when other alternatives are available.

Both of these executive orders were significant because they set in motion a review of wetland and floodplain policies by almost every federal agency. Several agencies such as the U.S. Environmental Protection Agency and the Soil Conservation Service established policies of wetland protection prior to the issuance of these executive orders (Kusler, 1983), but many other agencies such as the Bureau of Land Management were compelled to review or establish wetland and floodplain policies (Zinn and Copeland, 1982).

No Net Loss

A more significant initiative in developing a national wetlands policy was undertaken in 1987, when a National Wetlands Policy Forum was convened by the Conservation Foundation at the request of the U.S. Environmental Protection Agency to investigate the issue of wetland management in the United States

(National Wetland Policy Forum, 1988; Davis, 1989). The distinguished group of 20 members (which included three governors, a state legislator, state and local agency heads, the chief executive officers of environmental groups and businesses, farmers, ranchers, and academic experts) published a report that set significant goals for the nation's remaining wetlands. The forum formulated one overall objective:

> to achieve no overall net loss of the nation's remaining wetlands base and to create and restore wetlands, where feasible, to increase the quantity and quality of the nation's wetland resource base (National Wetland Policy Forum, 1988).

The group recommended as an interim goal that the holdings of wetlands in the United States should decrease no further, and as a long-term goal that the number and quality of the wetlands should increase. In his 1988 presidential campaign and in his 1990 budget address to Congress, President George Bush echoed the "no net loss" concept as a national goal, shifting the activities of many agencies such as the Department of the Interior, the U.S. Environmental Protection Agency, the U.S. Army Corps of Engineers, and the Department of Agriculture toward achieving a unified and seemingly simple goal. Nevertheless, it was not anticipated that there would be a complete halt of wetland loss in the United States when economic or political reasons dictated otherwise. Consequently, implied in the "no net loss" concept is wetland construction and restoration to replace destroyed wetlands. The "no net loss" concept became a cornerstone of wetland conservation in the United States in the early 1990s.

The Clean Water Act Section 404 Program

The primary vehicle for wetland protection and regulation in the United States is Section 404 of the Federal Water Pollution Control Act (FWPCA amendments of 1972 (PL 92–500) and subsequent amendments (also known as the Clean Water Act). The use of Section 404 for wetland protection has been controversial and has been the subject of several court actions and revisions of regulations. The surprising point about the importance of the Clean Water Act in wetland protection is that wetlands are not directly mentioned in Section 404. This section gave authority to the Army Corps of Engineers to establish a permit system to regulate the dredging and filling of materials in "waters of the United States." At first this directive was interpreted narrowly by the Corps to apply only to navigable waters. That definition of waters of the United States was expanded to include wetlands in two 1974–1975 court decisions, *United States* v. *Holland* and *Natural Resources Defense Council* v. *Calloway*. Those decisions, along with Executive Order 11990 on Protection of Wetlands, put the Army Corps of Engineers squarely in the center of wetland protection in the United States. On

July 25, 1975, the Corps issued revised regulations for the 404 program enunciated the policy of the United States on wetlands:

> As environmentally vital areas, [wetlands] constitute a productive and valuable public resource, the unnecessary alteration or destruction of which should be discouraged as contrary to the public interest (*Federal Register*, July 25, 1975).

Wetlands were defined in those regulations to encompass coastal wetlands ("marshes and shallows and . . . those areas periodically inundated by saline or brackish waters and that are normally characterized by the prevalence of salt or brackish water vegetation capable of growth and reproduction") and freshwater wetlands ("areas that are periodically inundated and that are normally characterized by the prevalence of vegetation that requires saturated soil conditions for growth and reproduction") (*Federal Register*, July 25, 1975, as cited by Zinn and Copeland, 1982). By those actions the jurisdiction of the Corps had been extended to include 60 million hectares of wetlands, 45 percent of which are in Alaska (Zinn and Copeland, 1982). Several times since 1975, the Corps has issued revised regulations for the dredge-and-fill permit program, and in 1985 the U.S. Supreme Court, in *United States* v. *Riverside Bayview Homes,* rejected the contention that Congress did not intend to include wetland protection as part of the Clean Water Act.

The procedure for obtaining a "404 Permit" for dredge-and-fill activity in wetlands is a complex process (Fig. 16–14). The decision to issue a permit rests with the corps' district engineer, and it must be based on a number of considerations, including conservation, economics, aesthetics, and several other factors listed in Figure 16–14. Assistance to the Corps on the dredge-and-fill permit process in wetland cases is provided by the U.S. Environmental Protection Agency, the U.S. Fish and Wildlife Service, and state agencies. The National Marine Fisheries Service also comments on coastal permit applications. The EPA has statutory authority to designate wetlands subject to permits, and also has veto power on the Corps' decisions. Some states require state permits as well as Corps permits for wetland development. The district engineer, according to Corps regulations, should not grant a permit if a wetland is identified as performing important functions for the public such as biological support, sanctuary, storm protection, flood storage, groundwater recharge, or water purification. An exception is allowed when the district engineer determines "that the benefits of the proposed alteration outweigh the damage to the wetlands resource and the proposed alteration is necessary to realize those benefits" (*Federal Register*, July 19, 1977). The effectiveness of the 404 Program has varied since the program began and has also varied from district to district.

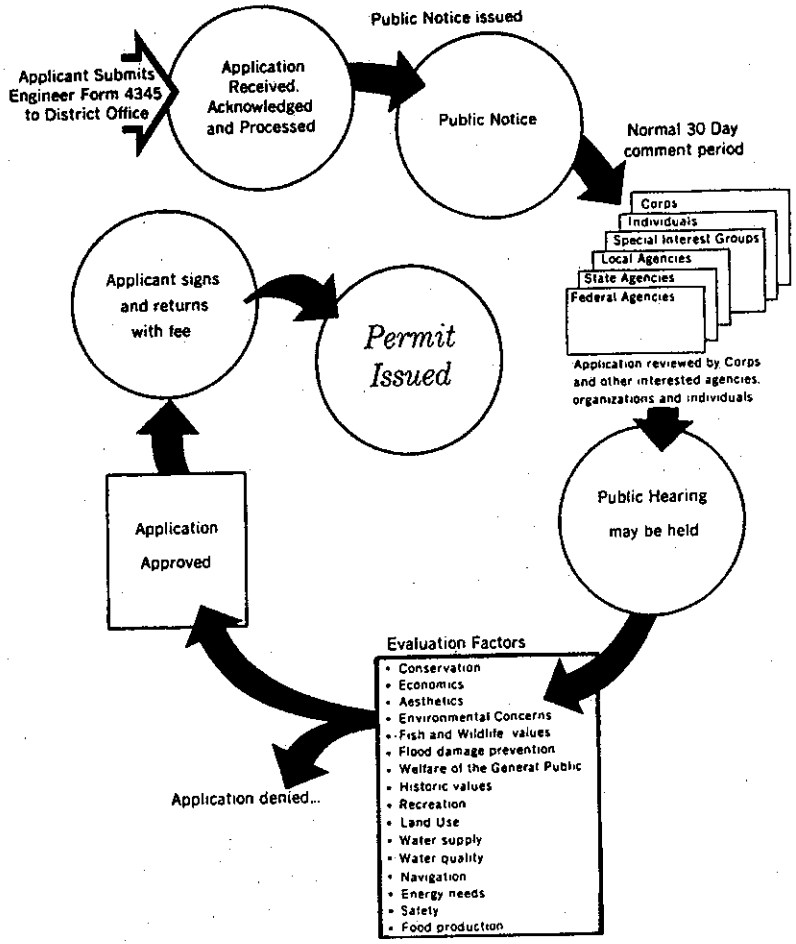


Figure 16–14. Typical U.S. Army Corps of Engineers review process for Section 404 dredge-and-fill permit request. (*From J. A. Kusler,* Our National Wetland Heritage: A Protection Guidebook; *copyright © 1983 by Environmental Law Institute, reprinted with permission*)

Swampbuster

Normal agricultural and silvicultural activities were exempted from the Section 404 permit requirements, thereby still allowing wetland drainage on farms and in commercial forests. Allowing such exemptions created conflict in the federal government: the Corps of Engineers and the Environmental Protection Agency were encouraging wetland conservation through the Clean Water Act, and the Department of Agriculture was encouraging wetland draining by providing Federal subsidies for drainage projects. The conflict ended when Congress passed, as part of the 1985 Food Security Act, the "Swampbuster" provisions that denied federal subsidies to any farm owner who knowingly converted wetlands to

farmland after the act became effective. The "Swampbuster" provisions of the act drew the U.S. Soil Conservation Service into federal wetland management, primarily as an advisory agency helping farmers identify wetlands on their farms. The Soil Conservation Service also administers a Wetlands Reserve Program that was set up in 1990 to acquire easements on up to 400,000 hectares (one million acres) of agricultural land that was formerly wetland.

Wetland Delineation

To be able to determine whether a particular piece of land was a wetland and therefore if it was necessary to obtain a federal 404 permit to dredge or fill that wetland, federal agencies, beginning with the Corps of Engineers, began to develop guidelines for the demarcation of wetland boundaries in a process that came to be named *wetland delineation*. In 1987 the Army Corps of Engineers published a technical manual for wetland delineation. Subsequent to that, the Environmental Protection Agency, the Soil Conservation Service, and the U.S. Fish and Wildlife Service developed separate documents for their respective roles in wetland protection. Finally, in January 1989, after several months of negotiation, a single *Federal Manual for Identifying and Delineating Jurisdictional Wetlands* was published by the four federal agencies to unify the government's approach to wetlands. This manual specified three mandatory technical criteria, namely wetland hydrology, soils, and vegetation, for a parcel of land to be declared a wetland. The manual also provided some guidance about how to use field indicators such as water marks on trees or stains on leaves to determine recent flooding, wetland vegetation (from published lists), and hydric soils indicators such as mottling. The manual was used by developers and agencies alike to prove or disprove the presence of wetlands in the Section 404 permit process. Consulting firms specializing in wetland delineation sprung up overnight, and short courses on the methodology became very popular.

Beginning in early 1991, modifications of the manual were proposed in response to heavy lobbying by developers, agriculturalists, and industrialists for a relaxing of the wetland definitions, supposedly to lessen the regulatory burden on the private sector. A new manual was published for public comment in August 1991 but was quickly and heavily criticized for its lack of scientific credibility and unworkability (Enviromental Defense Fund and World Wildlife Fund, 1992) and it was eventually abandoned in 1992. In the meantime, the 1987 Corps technical manual is being used until some other version is adopted. Although wetland determination and delineation will remain important tools for wetland managers, the exact rules for using these tools will remain uncertain and subject to political change for many years to come.

Other Federal Activity

Several other federal laws and activities have led to wetland protection since the 1970s. The Coastal Zone Management Program, established by the Coastal Zone

Management Act of 1972, has provided up to 80 percent of matching-funds grants to states to develop plans for coastal management based on giving a high priority to protecting wetlands. The National Flood Insurance Program offers some protection to riparian and coastal wetlands by offering federally subsidized flood insurance to state and local governments that enact local regulations against development in flood-prone areas. The Clean Water Act, in addition to supporting the 404 Program, authorized six million dollars to the U.S. Fish and Wildlife Service to complete its inventory of wetlands of the United States (see Chap. 18). The Emergency Wetlands Resource Act passed by Congress in 1986 required the U.S. Fish and Wildlife Service to update its report on the status of and trends in wetlands every ten years. The first report was issued in 1982 and published one year later (Frayer et al., 1983). The first update was published in 1991 as Dahl et al. (1991) (see Chap. 3 for conclusions in these reports).

Table 16–3. States with Coastal Wetland Protection Programs

State	*Program*
Alabama	Permits are required for activities in coastal zone (dredging, dumping, etc.) that alter tidal movement or damage flora and fauna.
Alaska	State agencies regulate use of coastal land, waters, including offshore areas, estuaries, wetlands, tideflats, islands, sea cliffs and lagoons.
California	Permit required for development up to 1,000 yards (meters) of mean high tide; coastal zone regulated by regional regulatory boards; prohibits siting coastal-dependent developments in wetlands with some exceptions that must be permitted.
Connecticut	Permit required for all regulated activity; state inventory required.
Delaware	Permits required for all activities; has both Coastal Zone and Beach Protection Acts.
Florida	Florida Coastal Zone Management Act requires permit for erosion-control devices and excavations or erections of structures in coastal environment.
Georgia	Permits required for work in coastal salt marshes through Coastal Marshlands Protection Program.
Hawaii	County authorities issue development permits for development of coastal area with state oversight.
Louisiana	State and/or local permits required for activity in coastal wetlands. Coastal Wetland Planning, Protection and Restoration Act passed in 1990 to restore coastal wetlands.
Maine	Permits required for dredging, filling, or dumping into coastal wetlands. Comprehensive coastal/freshwater protection in Protection of Natural Resources Act.
Maryland	State permits required for activity in coastal wetlands based on Tidal Wetlands Act and Chesapeake Bay Critical Area Act.

continued on next page

The "Takings" Issue

As discussed in Chapter 15, one of the dilemmas of valuing and protecting wetlands is that the values accrue to the public at large but rarely to individual landowners who happen to have a wetland on their property. In a major ruling in June 1992 *(Lucas* v. *South Carolina)*, the U.S. Supreme Court ruled that regulations denying "economically viable use of land" require compensation to the landowner, no matter how great the public interest served by the regulations (Runyon, 1993). The denial of an individual's right to use his or her property is referred to as a "taking." This case was referred back to the State of South Carolina to determine if the developer, David Lucas, was denied all economically viable use of his land (beachfront property that was rezoned by South Carolina in response to the Coastal Zone Management Act). The ultimate resolution of the takings issue in this and other pending court cases could have significant implications on Federal and state regulations of wetlands on private property.

Table 16–3 continued

State	*Program*
Massachusetts	State and local permits required for fill or alteration of coastal wetlands. Permits from local conservation commissioners.
Michigan	Permit required for development in high rule erosion areas, flood risk areas, and environmental areas of coastal Great Lakes.
Mississippi	Permits required for dredging and dumping, although there are many exemptions through Coastal Wetlands Protection Act.
New Hampshire	Permit required for dredge and fill in or adjacent to fresh and saltwater wetlands; higher priority usually given to saltwater marshes.
New Jersey	Permit required for dredging and filling; agriculture and Hackensack meadowlands exempted.
New York	Permits required for tidal wetland alteration by Tidal Wetlands Act.
North Carolina	State permit required for coastal wetland excavation or fill of estuarine waters, tidelands, or salt marshes.
Oregon	Local zoning requirements on coastal marshes and estuaries with state review.
Rhode Island	Coastal wetlands designated by order and use limited; permits required for filling, aquaculture, development activity on salt marshes.
South Carolina	Permits required for dredging, filling, and construction in coastal waters and tidelands including salt marshes.
Virginia	Wetlands Act requires permits for all activities in coastal counties with some exemptions; also 1988 Chesapeake Bay Preservation Act.
Washington	Shoreline Management Act requires local governments to adopt plans for shorelines, including wetlands; state may regulate if local government fails to do so.

Source: After Zinn and Copeland, 1982; Kusler, 1979, 1983; Want, 1990; Meeks and Runyon, 1990

State Management of Wetlands

Many individual states have issued wetland protection statutes or regulations. That activity has been described in a number of summaries, including those by Kusler (1979, 1983), Zinn and Copeland (1982), Glubiak et al. (1986), Meeks and Runyon (1990), Want (1990), and Environmental Defense Fund and World Wildlife Fund (1992). State wetland programs may become more important as the federal government attempts to delegate much of its authority to local and state governments. Kusler (1983) has suggested that although local communities may also have wetland-protection programs, states are much more probable governmental units for wetland protection for the following reasons:

1. Wetlands cross local government boundaries, making local control difficult.
2. Wetlands in one part of a watershed affect other parts that may be in different jurisdictions.
3. There is usually a lack of expertise and resources at the local level to study wetland values and hazards.
4. Many of the traditional functions of states such as fish and wildlife protection are related to wetland protection.

Many states that contain coastlines initally paid more attention to managing their coastal wetlands than to managing their inland wetlands (Kusler, 1983). This is a result of an earlier interest in coastal wetland protection at the federal level and to the development of coastal zone management programs. Table 16–3 shows some of the states that have coastal wetland protection programs. In general, those programs can be divided into those that have been based on specific coastal wetland laws and those that are designed as a part of broader regulatory programs such as coastal zone management. Several coastal states have coastal dredge-and-fill permit programs, whereas other states have specific wetland regulations administered by a state agency.

State programs for inland wetlands, although in an earlier stage of development, are more diverse, ranging from comprehensive laws to a lack of concern for inland wetlands. Comprehensive laws have been enacted in several states such as Connecticut, Rhode Island, New York, Massachusetts, Florida, New Jersey, and Minnesota (Table 16–4). Other states such as Arizona, Georgia, and Idaho have few regulations governing inland wetlands. Between these two extremes, there are many states that rely on federal-state cooperation programs or on state laws that indirectly protect wetlands. Only one state, Michigan, has assumed responsibility from the Federal government to issue Section 404 permits, although the Corps of Engineers retains the permit program in navigable waters (Meeks and Runyon, 1990) and the U.S. EPA retains Federal oversight of the program. Floodplain protection laws or scenic and wild river programs are being implemented in more than half of the states and are often effective in slowing the destruction of riparian wetlands. States are also involved in wetland protection through wetland acquisition programs, conservation easement programs, preferential tax treatment for landowners who protect wetlands, and enforcement of state water quality standards as required by the Clean Water Act (Meeks and Runyon, 1990).

Table 16–4. States that Have Comprehensive Wetland Laws for Inland Waters

State	*Law*
Connecticut	Inland Wetlands and Watercourses Act
Delaware	The Wetlands Act
Florida	Henderson Wetlands Protection Act of 1984
Maine	Protection of Natural Resources Act
Maryland	Chesapeake Bay Critical Area Act
Massachusetts	Wetland Protection Act
Michigan	Goemaere–Anderson Wetland Protection Act
Minnesota	The Wetland Conservation Act of 1991
New Hampshire	Fill and Dredge in Wetlands Act
New Jersey	Freshwater Wetlands Protection Act of 1987
New York	Freshwater Wetlands Act
North Dakota	No Net Wetlands Loss Bill of 1987
Oregon	Fill and Removal Act
	Comprehensive Land Use Planning Coordination Act
Rhode Island	Freshwater Wetlands Act
Vermont	Water Resources Management Act
Wisconsin	Water Resources Development Act
	Shoreland Management Program

Source: Want, 1990; Meeks and Runyon, 1990

INTERNATIONAL WETLAND CONSERVATION

The Ramsar Convention

Intergovernmental cooperation on wetland conservation has been spearheaded by the Convention on Wetlands of International Importance, more commonly referred to as the *Ramsar Convention* because it was initially adopted at an inter-

national conference held in Ramsar, Iran, in 1971. The global treaty provides the framework for the international protection of wetlands as habitats for migratory fauna that do not observe international borders and for the benefit of human populations dependent on wetlands. The specific obligations of countries that have ratified the Ramsar Convention are the following:

1. Member countries shall formulate and implement their planning so as to promote the "wise use" of all wetlands in their territory, and develop national wetland policies.
2. Member countries shall designate at least one wetland in their territory for the "List of Wetlands of International Importance." The so-called Ramsar sites should be developed based on their "international significance in terms of ecology, botany, zoology, limnology or hydrology" (Navid, 1989). Currently there are 11 Ramsar sites comprising 1.1 million hectares in the United States, 30 sites of almost 13 million hectares in Canada, and 1 site of 47,000 hectares in Mexico. As of 1993, almost 37 million hectares at 582 wetland sites were designated as Ramsar sites in the world.
3. Member countries shall establish nature reserves at wetlands.
4. Member countries shall cooperate over shared species and development assistance affecting wetlands.

Currently 74 countries have joined the Ramsar Convention. A permanent secretariat headquartered at the International Union of Conservation of Nature and Natural Resources (IUCN) in Switzerland was established in 1987 to administer the convention, and a budget based on the United Nations scale of contributions was adopted.

North American Waterfowl Management Plan

The United States and Canada, partially as a result of collaboration begun by the Ramsar Convention, established the *North American Waterfowl Management Plan* in 1986 to conserve and restore about 2.4 million hectares of waterfowl wetland habitat in Canada and the United States. This treaty was formulated as a partial response to the steep decline in waterfowl in Canada and the United States that had become apparent in the early 1980s (see Chap. 15). This bilateral treaty is jointly administered by the U.S. Fish and Wildlife Service and the Canadian Wildlife Service but also involves public and private participation by groups such as Ducks Unlimited. The total cost of this plan was estimated to be $1.5 billion, to be paid by the two countries and private organizations. Major emphasis has been placed on sites that cross international borders, including the prairie pothole region, the lower Great Lakes-St. Lawrence River Basin, and the Middle-Upper Atlantic Coastline (Larson, 1991).

Wetland Creation and Restoration

17

Policies such as "no net loss" of wetlands and the recognition of wetland values have stimulated restoration and creation of these systems. Restored or created wetlands have specific objectives such as the mitigation of unavoidable wetland losses, wildlife enhancement, domestic wastewater treatment, coal mine drainage control, and stormwater retention and control. Although many of these constructed and restored wetlands have been successful in providing the desired results, there have been some cases of "failure" of constructed or restored wetlands generally caused by a lack of proper hydrology. Ecological engineering of wetlands is based on the concept of self-design whereby the ecosystem adapts and changes according to its physical constraints, leading to a minimum of human intervention.

Some wetland restoration involves little more than restoring the natural hydrologic conditions. Other wetland creation projects involve paying more attention to design detail. Among the hydrologic design parameters to be considered for constructing wetlands are hydroperiod, loading rates, seasonal pulses, flow patterns, and retention times. Wetland managers in the past have used mainly water depth to control the functioning of wetlands; a more comprehensive management of the flow-through characteristics of the wetland is needed. Chemical loading rates are important for wetlands designed for water pollution control and guidelines are available on nitrogen, phosphorus, and iron. Substrate characteristics such as organic content, texture, nutrients, iron, and aluminum play important roles in wetland design and construction. A wide variety of vegetation types and planting and seeding techniques are available for wetland construction. Vegetation success should be measured more by the

Certified Mail: HAND DELIVERED

WETLANDS PERMIT #IW-516

March 18, 2009

Town of Enfield
Public Works Department
820 Enfield Street
Enfield, CT 06082

Dear Enfield Public Works Department,

At a regular meeting held March 17, 2009, the Enfield Inland Wetlands and Watercourses Agency took the following action:

IW-516 – Town of Enfield Dept. of Public Works – Application proposing the extension of a drainage outlet to prevent soil erosion located to the east of Sun Street and to the south of Play Road (map: 06, lot: 276 zone: R-33). Activities are proposed to be located within the regulated area. **Approved with conditions.**

The permit is issued subject to the following conditions of approval:

STANDARD CONDITIONS

Prior to the start of construction:

1. The Inland Wetlands and Watercourses Agency or its designated Agent must be notified in writing within two business days of the commencement of permitted activities, and upon completion of said activities; a "business day" is a day when the Town Hall is open for business.

2. Prior to the start of construction or, if applicable, the issuance of a building permit the half-sized (approximately 11" x 17") plans as approved by the Agency and the Planning and Zoning Commission shall be submitted to the Inland Wetlands Agent;

3. The permittee/contractor shall schedule a pre-construction meeting with the Inland Wetlands Agent to be held no sooner than two weeks before the regulated activities are to begin. The permittee shall, at that time, review with the Inland Wetlands Agent, the procedures to be taken to protect the regulated areas prior to and during construction;

4. Prior to the start of work, the permittee shall submit an electronic copy of the existing conditions plan that shows the wetland boundary in accordance with the "Town of Enfield, CT Geographic Information Systems Electronic Submittals Ordinance."

General Conditions of Approval:

5. This permit shall be valid for 5 years from the date of approval unless otherwise revoked or specifically extended;

6. All work and all regulated activities conducted pursuant to this permit shall be consistent with these terms and conditions hereof. Any structures, excavation, fill, obstruction, encroachments or regulated activities not specifically identified and authorized herein shall constitute a violation of this permit and may result in its modification, suspension, or revocation. Upon initiation of the activities authorized herein, the permittee thereby accepts and agrees to comply with the terms and conditions hereof;

7. This permit is not transferable without the written consent of the Enfield Inland Wetlands and Watercourses Agency;

8. In issuing this permit, the Agency has relied on information provided by the applicant and, if such information subsequently proves to be false, deceptive, incomplete and/or inaccurate this permit shall be modified, suspended or revoked;

9. This permit shall be made a part of all construction contracts and sub-contracts pertaining to the proposed regulated activities and shall supersede all other contract requirements;

10. The permittee shall permit the Agency, its authorized representative(s) or designee(s) to make periodic inspections at any time deemed necessary in order to assure that the activity being performed under authority of this permit is in accordance with the terms and conditions prescribed herein;

11. No equipment or material including without limitation, fill, construction materials, or debris, shall be deposited, placed, or stored in any wetland or watercourse on or off site unless specifically authorized by this permit;

12. This permit is subject to and does not derogate any present or future property rights or other rights or powers of the Town of Enfield, and conveys no property rights or in real estate of material nor any exclusive privileges, and is further subject to any and all public and private rights and to any activity affected hereby;

13. Prior to the start of construction, adequate erosion and sedimentation control measures shall be implemented, and shall be maintained throughout the entire construction phase and shall meet or exceed the 2002 Connecticut Guidelines for Soil Erosion and Sediment Control, as revised, until the site has become stabilized with permanent vegetative cover. The construction site shall be left in a stable condition at the close of each day. An adequate stockpile of erosion control materials shall be on site at all times for emergency or routine replacement and shall include materials to repair silt fences, haybales, mulch, stone-riprap filter dikes or any other devices planned for use during construction. Additional erosion/stormwater control measures are to be installed as directed by the Inland

Wetland Agency, its authorized representative(s) or designee(s) if field conditions necessitate. The permittee shall immediately inform the Department of Planning and Community Development of any problems involving wetlands or watercourses which have developed in the course of, or which are caused by, the authorized work;

14. All temporary barriers, including erosion and sedimentation controls are to be removed upon completion of the project in suitable weather conditions;

15. With the exception of the addition of the items stated in these conditions, this application is approved in accordance with the plans entitled:

    - "Plan of Play Road Storm Drainage Outlet Stabilization Project, Enfield, CT." Prepared by and for Town of Enfield, Public Works Department Engineering Division, 820 Enfield Street, Enfield, CT 06082, Sheets 1 through 5, dated January 14, 2009, most recently revised March 17, 2009.

    Any changes that would potentially cause greater impact to wetlands or watercourses, such as enlargement of the area of disturbance or reorientation of building footprints, from the plans shall require the permitee to come before the Enfield Inland Wetlands and Watercourses Agency for a Determination of Permit Need (Jurisdictional Ruling) or Permit Modification.

16. A copy of the As-Built plan with the topography certified to T2 accuracy shall be submitted to the Agency upon completion of the project to ensure compliance with this approval. In addition an electronic copy of the As-Built plan shall be submitted in accordance with the "Town of Enfield, CT Geographic Information Systems Electronic Submittals Ordinance".

Special Conditions of Approval:

17. The site contractor shall certify to the Wetlands Agent that any fill or top-dressing brought on site is free of seeds and fragments of invasive species.

18. Any dewatering during excavation shall pass through the appropriate filtration system prior to discharging off-site or to any regulated area. The use of filtered sumps, and crushed stone wrapped in filter fabric and stilling basins should be used to minimize the silt and soil fined transport.

19. The project is permitted with the intent that all proposed activities in both phase 1 and 2 will be completed prior to the expiration of this permit. This primary purpose of this project is mitigation, which requires the completion of the entire project to fulfill its intent.

20. All slopes greater than 3:1 shall be stabilized with erosion control blankets designed to stabilize said slope.

NOTE: This permit does not relieve the applicant from his responsibility to apply for any other permits required by local, state or federal agencies.

This authorization constitutes the permit required by Section 22a-39 of the Connecticut General Statutes. The decision legal notice will be published in the Journal Inquirer on Wednesday March 25, 2009. Please note that the appeal period (15 days) begins as of the date of publication in accordance with Section 8-8 of the State Statutes.

Issuance of the Inland Wetlands and Watercourses permit does not abrogate the responsibility to obtain permits that may be necessary from other agencies at the local, state or federal level prior to commencing your project.

Please ensure you review the conditions of approval thoroughly and note that **a pre-construction meeting is required as per condition #3, prior to commencement of any activity on site**. If you have any questions, please feel free to contact me at 253-6358. Office hours are 9:00 AM to 5:00 PM, Monday through Friday. Voice mail is available after business hours.

Sincerely,

Katie A. Bednaz
Assistant Town Planner/Wetlands Agent

cc: File IW#516
Jose Giner, Director of Planning and Development

APPROVAL OF MINUTES

April 29, 2010 & May 4, 2010

Inland Wetlands and Watercourses Meeting

INLAND WETLANDS AND WATERCOURSES AGENCY
MINUTES OF A SPECIAL MEETING
THURSDAY, April 29, 2010

A Special Meeting of the Enfield Inland Wetlands and Watercourses Agency was held on Thursday, April 29, 2010 in the Enfield Room, Enfield Town Hall, 820 Enfield Street, Enfield, Connecticut.

MEMBERS PRESENT:	Douglas Maxellon, Chairman Maryann Abar, Alternate Joseph Albert, Karen Camidge Jo-Marie Nelson (7:31 p.m.)
MEMBERS ABSENT:	Robert Lemay Brian Peruta Robie Staples Patrick Szczesiul, Alternate
ALSO PRESENT:	Katie Bednaz, Wetlands Agent Susan Berube, Recording Secretary

SPECIAL MEETING

1. Call to Order: The meeting was called to order by Chairman Douglas Maxellon at 7:10 p.m.

2. Roll Call: Present were: Chairman Maxellon and Agents Abar, Albert, Camidge and Nelson (7:31 p.m.). Also present were Katie Bednaz, Wetlands Agent and Susan Berube, Recording Secretary.

3. Other Business

a. IWWA Regulation Revisions: Agency members compared the State's Model Regulations with the Town's current IWWA regulations, sections 7.6 through 9.4.

Before beginning work on section 7.6, members briefly reviewed 7.5 again.

During discussion of 7.5(e), Agent Albert requested that plan details be in color for easier review. Chairman Maxellon noted that this could be a burden to the applicant, as color copies are expensive.

Ms. Bednaz suggested that the presentation copy be in color and it was the consensus of the Agency members to add this to 7.5(e).

Agent Nelson arrived at 7:31 p.m.

Section 7.6 was reviewed at length, moving (d) and (i) to section 7.5, combining (e) with 7.5, and deleting 7.6 (h) and (k).

Section 7.7 was not discussed.

Section 7.8, 1st paragraph will be the D.E.P. version of 7.6; 7.8(a) to be merged with 7.6(e); 7.8(d) to be the proposed version by Mr. Sadlowski; 7.8(f) and (g) to be D.E.P. version of 7.6(f) and (g) respectively; delete 7.8 (h), (i), and (j).

Agent Albert expressed concern over the IWWA's potential liability on water leaving a subject site and flooding other properties.

Ms. Bednaz explained that the regulations allow for more water to leave a property but not with more intensity.

She added that she will research to see where the CT Storm Water Management Manual should be referenced in the regulations.

Also discussed, in relation to section 7.6, was members' desire to address when geotechnical analysis would be required for sites having escarpment soils. It was noted that newer soil maps do not include escarpment soil locations.

Section 7.9 to be replaced with D.E.P. version of 7.7.

Section 7.10 – delete

Section 7.11, change (9) copies to (12) copies in the 1st sentence.

Members discussed how to inform an applicant which parts of section 7.6 may be required for an application.

Ms. Bednaz suggested adding criteria to 7.6 and adding "shall" verses "may" be required or waived, as appropriate.

Section 7.12 – the 1st section of the current version is to be kept and the 2nd paragraph of the D.E.P. version of 7.13 is to be added.

Section 8.1 to remain, adding the 1st section of the D.E.P version.

Sections 8.2-8.7 to remain; 8.9 to become 8.8.

All references in the Town's Regulations to "Planning Department" to be changed to "Department of Developmental Services".

Section 9.1 to be replaced with D.E.P. version of 9.1.

Section 9.2 to remain. Agency members discussed the D.E.P.'s version that requires residency in Enfield in order to sign a petition requesting a public hearing. Ms. Bednaz will check on this with the Town's attorney.

Section 9.3 – Agency members discussed the difficulties in notifying all owners of condominium units. Signage posted on the subject property would not properly notify absentee owners of a proposed project.

Agents Camidge and Abar expressed their appreciation for written notice.

After lengthy discussion, it was the consensus of the Agency members to notify abutters as defined earlier in the regulations, keeping the reference to "Per IW 126-Effective April 17, 1991". Ms. Bednaz will check to see what this is in reference to.

Section 9.4 to be deleted.

4. Adjourn: Agency members were encouraged to review upcoming sections of the regulations prior to the next special meeting.

A motion was made by Agent Albert and seconded by Agent Nelson to adjourn the meeting at 9:12 p.m. Vote was 4-0-0.

Respectfully Submitted,

_____

Jo-Marie Nelson, Secretary

Inland Wetlands and Watercourses Meeting

INLAND WETLANDS AND WATERCOURSES AGENCY MINUTES OF A REGULAR MEETING TUESDAY, May 4, 2010

A Regular Meeting of the Enfield Inland Wetlands and Watercourses Agency was held on Tuesday, May 6, 2010 in the Council Chambers, Enfield Town Hall, 820 Enfield Street, Enfield, Connecticut.

MEMBERS PRESENT:	Douglas Maxellon, Chairman Karen Camidge Maryann Abar, Alternate Joseph Albert Robert Lemay Jo-Marie Nelson Brian Peruta Robie Staples Patrick Szczesiul, Alternate
MEMBERS ABSENT:	Jennifer Sierra, Alternate
ALSO PRESENT:	Katie Bednaz, Wetlands Agent Susan Berube, Recording Secretary

REGULAR MEETING

1. Call to Order: The meeting was called to order by Chairman Douglas Maxellon at 7:00 p.m.

2. Roll Call: Present were: Chairman Maxellon and Agents Abar, Albert, Camidge, Lemay, Nelson, Peruta, Staples and Szczesiul. Also present were Katie Bednaz, Wetlands Agent and Susan Berube, Recording Secretary. Chairman Maxellon announced the appointment of Alternate member Jennifer Sierra.

3. Pledge of Allegiance: The Pledge of Allegiance was recited.

4. Executive Session
(Matters regarding specific employees, pending litigation, acquisition of real estate and / or matters exempt from disclosure requirements): None.

5. Public Hearing
a. **XIW-10-04 - Town of Enfield Public Works** - is requesting a permit to reconstruct and enlarge the South Maple Street Bridge over the Scantic River (Map 84, Lots 7, 12, 14 and 21). Submitted 3/3/10, received 3/16/10, PPE 3/30/10, **MPHCD 5/11/10.** Mr. Piya Hawkes, Public Works Director, and Mr. Jeff Scala, P.E., represented the applicant.

Mr. Hawkes explained that Mr. Scala had reviewed the erosion problem taking place at the south end of the bridge, on private property and discussed at length at the previous meeting and came up with a quick design.

However, at the direction of the Town Manager, this will not be part of the project. If later directed by the Town Manager, Mr. Hawkes stated that he would approach the property owner. There are funds in the CIP account to cover the cost of the repair.

Mr. Scala reviewed the plan proposed by the Enfield Conservation Commission regarding placing an outfall behind the pump house and creating a grass lined swale. It would end up being a very deep system with a deep outfall at a 20% grade. That would be too steep to support vegetation, requiring additional rip rap, likely very large pieces. It would also not be economically feasible and would not pick up nutrients, as proposed. He does not believe this to be a prudent alternative.

Ms. Bednaz briefly reviewed the proposed conditions of approval. She noted that the 9th line of condition #21 mentions that the inspector is to be knowledgeable in wetlands.

Agent Nelson asked about the intervals of reports. The conditions refer to weekly reports but asked if they should be bi-weekly, to coincide with the inspections.

Members then discussed the experience and credentials that should be required of the inspector.

Agent Nelson asked what the alternative to a CPESC certified inspector would be.

Ms. Bednaz explained that the person would be knowledgeable in erosion and sedimentation control matters. The Agency could also specify other types of knowledge preferred.

Agent Nelson asked if the vendor list for this project includes a CPESC certified inspector.

Mr. Hawkes stated that the vendor does not have a certification but has 42 years experience working in this field.

Agent Nelson, referring to condition #13, asked what "in the dry" referred to, or if it was a mistake.

Mr. Scala replied that it is a technical term, meaning that work needs to be done in a dry area, not in water.

Agent Camidge asked who the IWWA agent would be, in condition #21.

Ms. Bednaz replied that it would be herself or a representative of the IWWA or the Agency itself.

Agent Staples stated that he recently visited the site and noted that there is a pond behind the proposed block wall and asked if the pond will be destroyed as part of the project.

Mr. Scala replied that it is beyond the scope of the project and will not be touched.

Chairman Maxellon noted that the erosion, as shown in photos within the Agent's Report, will continue after completion of the project. It is hard to ignore what is there and he does not feel that it is right; some simple solution could be found. This is his only open item.

The soil heads to the catch basin located across the road and goes to the Scantic. If there were no project at this time, the IWWA would be going after the property owner.

After brief discussion, it was the consensus of the Agency that inspections would be made weekly.

Agent Albert asked if the park road is state property.

Mr. Hawkes replied that it is known as Cooper Street and is town-owned.

Mr. Scala reviewed the photos from the Agent's Report and noted that the erosion seems to be from the footpath located on private property. A swale will be established in the area which will help stop the soil from moving so far and will definitely help.

Chairman Maxellon felt that there could be a joint effort between the Town and the property owner. He feels there could be a simple solution, such as a swale with a curb on the property line.

At this time, the hearing was opened for public comment.

Gretchen Pfeifer-Hall of Somers Road, Enfield and member of the ECC spoke. She expressed her continued concern over the proposed project but assured the Agency that she is not against the bridge replacement.

She stated that she does not feel that the plan is well thought out for the run off and noted that the IWWA chairman feels that there will be sediment going across the road and eventually into the river.

She too has concerns over this and runoff from the road. She heard from the applicant that there is no time to negotiate with the D.E.P. or Connecticut Water Company so the applicant can't design the best project possible.

She believes that the project will be approved even though the IWWA knows that there will still be nutrients and sediment going into the river.

She also expressed concern that there will not likely be a Wetlands Agent to oversee the project.

Ms. Pfeifer-Hall also stated that she feels that the best person possible should be hired to inspect the project. She is not impressed with the fact that the person who will likely be doing the inspections was a D.O.T. employee. They've had issues, too.

She stated that the IWWA should be held to the highest standards possible.

Chairman Maxellon stated that the qualifications are in the proposed conditions of approval, which require a qualified person.

Ms. Pfeifer-Hall replied that perhaps she misunderstood. She heard that the person worked for the D.O.T. but did not have certification.

Chairman Maxellon agreed that this is true but that the person will be qualified, per the conditions of approval.

No one else in the audience came forward to speak for or against the project.

Chairman Maxellon asked Mr. Hawkes if he would like the public hearing closed.

Mr. Hawkes replied in the affirmative.

A motion was made by Agent Nelson and seconded by Agent Staples to close the public hearing for XIW-10-04 at 7:28 p.m. Vote was 7-0-0.

6. Call to Order of Regular Meeting: The regular meeting was called to order by Chairman Maxellon at 7:29 p.m. :

Present were: Chairman Maxellon and Agents Abar, Albert, Camidge, Lemay, Nelson, Peruta, Staples and Szczesiul. Also present were Katie Bednaz, Wetlands Agent and Susan Berube, Recording Secretary.

7. Public Participation - Issues of concern not on the agenda: None.

8. Correspondence: None.

9. Commissioner's Correspondence: Agent Peruta asked about the Weymouth Road project. He noted that there is a stockpile located on the right side of the road, possibly within the regulated area.

Ms. Bednaz replied that she hasn't seen the stockpiles yet but will check on them this week.

Agent Peruta explained that they are smaller piles but probably need more appropriate locations and suggested that perhaps the contractor could utilize the local school parking lot.

Ms. Bednaz noted that if these are very short term stockpiles, they should be fine but if they are for long-term storage, the contractor definitely needs to use best management practices.

Agency members updated the projects inspection list.

a. Site Visit Updates: None.

10. Approval of Minutes - April 15, 2010 & April 20, 2010: Because a quorum was not present for the meeting of April 15, 2010, no formal minutes were voted on.

A motion was made by Agent Nelson and seconded by Agent Camidge to approve the minutes of the meeting of April 20, 2010 with one amendment: page 7, 3rd paragraph, change "Peruta" to "Szczesiul". Vote was 5-0-2(Lemay, Staples).

11. Wetlands Agent Report: Ms. Bednaz briefly reviewed her written report.

Agent Peruta asked if the rip rap area at the plunge pool at the Play Road project has been cleaned out yet.

Ms. Bednaz replied that this was done at the end of the construction project but she does not believe that the contractor has been back to clean it again.

It is important to maintain erosion controls but there are no funds to do so. Both plunge pools have significant amounts of sediment in them.

It would require large machinery to clean them and if they are going to be cleaned, it should be done correctly. It all seems to be a money issue. Silt fence is not a long term solution to hold back the side slopes.

Agent Camidge noted that if this was a private owner, they would be in violation and she asked how this can be fixed.

Ms. Bednaz, using the example of the recent application from Mr. Butler, noted that like the property owner, the Town doesn't have the money to fix the problem so it has to be dealt with carefully.

Agent Peruta stated that when the Town came before the IWWA for this application, they were warned that this would happen. The applicant stated at that time that they would "come up with something", but obviously, they have not.

Ms. Bednaz stated that the IWWA can go through the violation process but questioned as to whether or not this is actually a violation. The area has been

improved, but was not a total fix. The main concern is for the houses located on top of the slope. If this was in an area with no houses, it would not be the same issue as it would be naturally occurring.

Agent Peruta noted that it was the Town's pipe that caused the original slumping. It looks good now, but it is not fixed.

Ms. Bednaz felt that it is debatable as to whether or not it is a violation. It is natural soils and a natural occurrence but agreed that the pipes are not natural. This could be pursued as a violation if the IWWA so wishes.

During further discussion, it was noted that the project did not work as planned. It has proven difficult to get the slopes stabilized for the long term.

Chairman Maxellon asked if all of the work has been done per the plans and conditions of approval.

Ms. Bednaz will check and will include the final conditions of approval in the Agency members' next packet. The Agency can then decide whether or not to pursue a violation. She added that she will put the plans on the FTP site.

Agent Peruta asked if the Army Corps of Engineers was involved in this project.

Ms. Bednaz stated that she believes it was considered a "Category I" which does not require their permit.

Ms. Bednaz briefly reviewed her Agent's Report. She noted that the project at 604 Enfield Street is ongoing. The plans are very confusing; at one point there was to be a fence in the rear of the lower parking lot. That was changed to plantings and then back to a fence and back to plantings again. The owner is very concerned about making sure that there is no further erosion and is working with Staff. Also, the snow stockpile signs are still needed, as is screening for the dumpster.

Ms. Bednaz reported that she met with the contractor for the Post Office Road project today. The contractor plans to start later this week and will be removing the invasive plants first. He will be starting at the bridge and working west, first.

The stockpile and staging area will be located at the Transfer Station and possibly on private property, which at this time is a zoning issue.

Chairman Maxellon noted that he recently spoke with the Town Manager regarding the procedure for the Enfield Conservation Commission to be able to review applications. The Town Manager asked that Ms. LaPlante contact him regarding this.

12. Old Business :

a. **XIW-10-04 - Town of Enfield Public Works** - is requesting a permit to reconstruct and enlarge the South Maple Street Bridge over the Scantic River (Map

84, Lots 7, 12, 14 and 21). Submitted 3/3/10, received 3/16/10, PPE 3/30/10, **MPHCD 5/11/10. A motion was made by Agent Camidge and seconded by Agent Albert to approve XIW-10-04.**

Agent Peruta stated that the erosion problem needs to be resolved as part of this, whether by the owner or by the Town. He does not want this to be like the Play Road project. He would like to let the Town figure it out.

Agent Camidge concurred. She added that she was glad that the applicant addressed Ms. Pfeifer-Hall's concerns but doesn't feel the Agency should let it go with the erosion problems.

Agent Abar agreed.

Chairman Maxellon agreed. The only other choice is to cite the landowner but he doesn't feel that is appropriate. A simple swale with a curb would fix the problem. He cannot support the project.

Agent Albert stated that this would go by the wayside if it were not for this project. The Town has known about the problem for a long time but never addressed it. He questioned the wisdom in stopping the project because of it. This has been going on as long as he can remember.

Agent Nelson stated that the area is located outside of the scope of the project. She agrees with Mr. Hawkes that precedent should not be set by the Town fixing it. She feels that it should not be stipulated to be included in the project – it is private property.

Agent Staples stated that he has been in town for over 50 years and it has always been a problem. He does not feel that it is a big problem but that the erosion on the other side of the bridge has more of an erosion problem. The Town could work this out with the owner.

Agent Peruta stated that it sounds reasonable that this is outside the scope of the project but he still wants it fixed and doesn't care who fixes it.

He does not want to say no to the project because it is too important but he will not vote yes without a solution and would prefer to hold off the vote until there is a solution.

Agent Nelson noted that all Agency members agree that this is outside the scope of the project. She suggested that the project be approved and then work on the problem and further suggested that Ms. Bednaz could address it with the landowner.

Agent Peruta stated that he was concerned that if the project is passed, the Agency will not have any leverage to get the problem fixed.

Agent Camidge noted that it does not seem like it's going to be expensive to fix and felt that the applicant should do whatever can be done on Town property.

Ms. Bednaz noted that the public hearing is closed. No new information can be submitted, including any resolution to fix the erosion problem. She added that the trail could have water bars installed. This would be a simple, straight-forward fix, without the need for an engineer.

Agent Albert asked that if this were not a Town owned project, would the IWWA require this fix.

Agent Staples noted that another project located up the street was required to have curbing go down the street.

Chairman Maxellon agreed that the erosion starts on private property but travels and ends up on town property. The catch basins are not likely to be maintained as they should be.

At this time, the vote was taken. Vote was 4-3(Lemay, Camidge and Maxellon)-0.

Ms. Bednaz stated that it is the Town's responsibility to work with the owner to get this problem fixed. She will work with Mr. Hawkes to approach the owner. If the owner is not agreeable to fixing this, then it will be addressed as a violation.

13. New Business: None.

14. New Applications to be Received: None.

a. Applications to be received after Town deadline for Agenda: None.

15. Other Business
a. IWWA Fines Ordinance
b. IWWA Fee Schedule
c. IWWA Regulation Revisions: A motion was made by Agent Nelson and seconded by Agent Staples to table items 15 a, b, and c to the special IWWA meeting scheduled for Wednesday, May 12, 2010 at 7:00 p.m. Vote was 7-0-0.

d. **Next regular meeting is Tuesday, May 18, 2010 at 7:00PM in the Council Chambers.**

16. Adjourn: A motion was made by Agent Nelson and seconded by Agent Camidge to adjourn the meeting at 8:29 p.m. Vote was 7-0-0.

Respectfully Submitted,

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Jo-Marie Nelson, Secretary